# ALASKA DEPARTMENT OF FISH AND GAME SUMMARY OF THE 1997 MANDATORY SHELLFISH OBSERVER PROGRAM DATABASE

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Regional Information Report[1] No. 4K98-50

Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, AK 99615

December 1998

[1] The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

## ACKNOWLEDGMENTS

Shellfish observers deployed during the 1997 Bering Sea/Aleutian Island fisheries collected the data summarized in this report. We would like to express our gratitude for their diligence in collecting biological and fisheries management information while living and working at sea, often for extended periods.

The Alaska Department of Fish and Game data entry staff of Tammy Chisum, Janet Colegrove, Patricia Polchies, and Nang Blackett are acknowledged for their timely data entry. We thank Lucinda Neel for final preparation of the report and other members of the Westward Region Shellfish staff for their assistance in compiling this summary.

Acknowledgment is also given to the Pacific Fisheries Information Network (PacFIN) for recognizing the importance of funding support for Bering Sea shellfish research.

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# INTRODUCTION

During the spring of 1988, the Alaska Board of Fisheries (BOF) mandated at-sea observer coverage for all vessels commercially processing king and *Chionoecetes bairdi* (Tanner) crab in Alaskan waters. Since then, the BOF has amended state shellfish regulations to include observer coverage in the Bering Sea *C. opilio* fishery. Regulations requiring observers on all vessels commercially fishing king crab in the Aleutian Islands were passed in the spring of 1995. In addition, board members granted authority to the Alaska Department of Fish & Game (ADF&G) to place observers on commercial vessels participating in other Alaskan shellfish fisheries when such action would facilitate the only means to collect biological and fishery management data. In recent years that has included all vessels participating in the Bering Sea/Aleutian Islands Korean hair crab fishery and all vessels targeting *C. tanneri, C. angulatus* and *L. couesi.*

Although observers devote a considerable amount of effort toward monitoring and documenting commercial vessel fishing activities for regulatory compliance, they also collect a substantial amount of biological data. These data have been useful for many applications, such as developing models for estimating relative stock abundance, defining male and female crab size/age distributions on an annual basis, chronicling species' reproductive cycles, and quantifying levels of incidental bycatch. Ultimately, the shellfish observer biological database provides a source of information to aid shellfish managers and the BOF in comprehensive management of Alaska's shellfish resources.

The database of biological and regulatory compliance information collected by observers is maintained by Westward Region ADF&G staff members. Archived information includes a variety of commercial fishing and shellfish biology statistics ranging from fished pot locations, gear types and soak duration, to the species composition of catches, the biological and legal crab carapace size distributions, and the reproductive status of female crabs.

In this report, compiled data were collected during fisheries primarily occurring within the 1997 calendar year. Due to the substantial volume of available statistics, the scope of data presented has been narrowed to include only the size composition and molt stages of commercially retained crabs, the documented incidence of illegally retained crabs, and the general results of random pot sampling. Beginning in 1995, estimates of catch per pot pull and estimated total catch for selected species and fisheries using harvest data have also been included in the report. Additionally, a summary of all species encountered in bycatch pot sampling is included for each fishery.

Topical statistics from the 1994, 1995, 1996, and 1997 seasons are occasionally included for comparative purposes. Any inconsistencies between findings presented in this document and previously published shellfish observer database reports are the result of updated summaries and interpretation of historical data.

Size distributions of retained crabs often include those collected in a number of fisheries by ADF&G personnel at shoreside processing locations. Additional information, including Bering Sea/Aleutian Islands fishery harvest statistics, has been provided by ADF&G Westward Region Staff (1998).

## METHODS

Comprehensive shellfish observer sampling methodologies are outlined in the most recent publishing of the ADF&G Shellfish Observer Field Manual (ADF&G 1993).

For purposes of this report, terms related to the discussion of sampled crabs are as follows:

*Carapace Length* (CL) - the straight line distance across the carapace from the posterior margin of the right eye orbit to the medial-posterior margin of the carapace; the biological size measurement of hair crabs, all species of *Paralomis* crabs, and all king crab species.

*Carapace Width* (CW) - the straight line distance across the carapace at a right angle to a line midway between the eyes to the medial-posterior margin of the carapace, not including the spines; the biological size measurement of *C. bairdi, C. opilio, C. tanneri,* and *C. angulatus*.

*Legal Size* - the straight line distance across the carapace of male crabs at a right angle to a line midway between the eyes to the medial-posterior margin, including the spines.

*Mature* - male and female crabs that have attained a biological size at which at least 50 percent or more of a random sample of individuals are physiologically capable of mating.

*Immature* - male and female crabs that have not attained a biological size at which 50 percent or more of a random sample of individuals are physiologically capable of mating.

*Soft shell* - crabs that have molted within the previous two months.

*New shell* - crabs that have molted within the preceding two to twelve months.

*Old shell* - crabs that have molted within the preceding twelve to twenty-four months.

*Very old shell* - crabs that have not molted within the preceding twenty-four months.

*Eyed Eggs* - embryoid eggs.

*Uneyed Eggs* - non-embryoid eggs.

*Ovigerous* - bearing embryos

*Mated/Barren* - female crabs not carrying eggs but showing signs of previously mating (based on evidence of egg clutch extrusion).

*Non-mated/Barren* - female crabs not carrying eggs and not exhibiting signs of prior mating activity (including immature crabs).

*Recruit* - male crabs at an age/size within one growth cycle beyond the minimum legal size established for the species.

*Post-recruit* - male crabs at an age/size greater than one growth cycle beyond the minimum legal size established for the species, which also includes old shelled crabs at or above the legal size.

During the 1997 Bering Sea/Aleutian Islands shellfish fisheries, observers were deployed on catcher-processor, floater-processor, and catcher-only vessels. Observers on board floater-processors have access only to pre-sorted and retained catches, while those placed on catcher-processor and catcher-only vessels are able to examine total pot contents prior to catch sorting.

### *Floater-Processors*

Catch deliveries to floater-processors are monitored by observers for regulations compliance regarding retention of legal crab species, sex, and size. Procedures consist of sampling 600 crabs randomly selected from individual vessel catches for regulatory compliance. This sample type is referred to as a 'legal tally'.

Biological data collected by observers on board floater-processors includes the measurement of 100 randomly selected crabs from each catch delivery to determine carapace size distribution and shell age condition. This type of sampling is referred to as 'retained biological measurements'. The mean weight of harvested crabs is also calculated from a vessel's catch; this is known as an average weight sample.

### *Catcher-Processors*

In addition to collecting the retained biological measurement, legal tally, and average weight samples, observers deployed on catcher-processors routinely examine randomly selected pots for species composition. This exercise is referred to as 'bycatch sampling'. Methodology includes enumerating all species in a pot, recording the carapace size, shell age, legal status, and presence of parasites of all commercially important crab species observed, and evaluating the reproductive condition of female crabs.

There are occasions when other vessels will deliver crabs to a catcher-processor. When this occurs the observer on the catcher-processor will sample the crabs delivered as they would if on a floating-processor.

### *Catcher-only Vessels*

Routine data collection objectives for observers on board catcher-only vessels are similar to those assigned to personnel deployed on catcher-processors, except that pot contents assessment is usually the primary at-sea sampling activity. Retained catches are inspected for regulations compliance (the legal tally sample) only on occasions when the vessel delivers to a processing facility. When a vessel transfers harvested crabs to an at-sea processor, legal tally, retained biological measurements, and average weight samples are collected concurrently by observers deployed on each vessel.

Daily observer sampling goals on catcher-processors and catcher-only vessels (regarding the quantity of fished pots examined, crabs measured, etc.) are dependent on a number of variables, such as whether an individual has been assigned any special data collection projects, the anticipated duration of the fishery in which the observer is deployed, and the data collection priorities established by ADF&G. Fishery-specific sampling goals are discussed in subsequent sections where appropriate.

Several special shellfish research assignments were carried out by observers on board catcher-processors and catcher-only vessels during 1997. These included: recording carapace length, width and height data from *C. opilio* crabs for use in escape ring studies; collecting individual weights from hair crabs and Bristol Bay red king crabs; collecting morphometric measurements from *C. opilio* crabs for size-at-maturity estimation; investigating the prevalence of snailfish egg masses within *L. couesi* king crabs carapaces; tagging red king crabs in the Aleutian Islands; and sampling red king crabs in Bristol Bay for injury assessment and on deck aerial exposure. The results from these investigations have not been included in this report.

### *Estimation of Catch Per Unit Effort (CPUE) and Total Fishery Catch*

Estimates for CPUE and their standard errors were generated using weighted formulas for stratified sampling (Cochran 1977; Appendix A-1). With this technique each vessel-day is considered a separate stratum. The weights reflect the relative importance of a vessel's daily sampling compared to all the days on which sampling occurred -- the more pots sampled on a given day, the greater the weight for that day. Variances were calculated for each vessel-day and then summed over all vessels and all days for the entire fishery.

As can be seen in the tables displaying the standard error estimates (Tables 4, 9, 15, 22, 27) there are several ways to calculate CPUE. Multiple estimates are included not to confuse the reader, but rather to provide a range of information and a basis for comparison. The 'sample' CPUE is generated from observer data, and is based solely on the sampled bycatch pots. This is the estimate which has been reported in past observer reports (Tracy 1994, 1995a, 1995b; Boyle et al., 1996, 1997). It is calculated as total catch from sampled pots divided by total pots sampled. The 'weighted' CPUE uses the Cochran stratified technique as described above and in Appendix A-1. Weighted estimates and standard errors were calculated with Cochran's method for those crab species with a 'sample' CPUE greater than one. The 'actual total fishery' (ATF) CPUE is based on fish ticket information as reported in the annual management reports on shellfish fisheries of the Westward Region (ADF&G Westward Region staff 1998). The 'actual observed fleet' (AOF) CPUE is generated from confidential interviews with the vessel's captain, which are performed by onboard observers or dockside samplers. The ATF and AOF CPUE's are generated for retained legal crabs only. Both provide information on total catch of retained crab, total pots pulled and fishing locations. Information from confidential interviews is recorded on a daily basis (fish tickets reflect an entire trip between deliveries) and is generally considered more accurate than information obtained from fish tickets.

Estimated catch totals are derived by multiplying the CPUE estimates by the total number of pots pulled in the fishery. For those fisheries with 100 percent observer coverage the total pots pulled information is taken from confidential interviews. Otherwise the total pots pulled data is taken from fish ticket summaries.

When viewing CPUE and total catch estimates for both the directed catch and bycatch, the reader should note the precision and accuracy of the estimates as indicated by the standard errors and by the comparability of the estimates for legal retained crabs obtained from observer data with those obtained from confidential interviews and fish tickets. The reader should also take note of whether the CPUE and total catch estimates provided here were based on data gathered by observers deployed on all participating fishing vessels or by observers deployed on catcher-processor vessels only. Application of CPUE estimates obtained from catcher-processor vessels to the entire fishing fleet assumes that catch rates for that distinct portion of the fleet are comparable to the remaining, catcher-only vessel component of the fleet.

## RESULTS AND DISCUSSION

### *Bering Sea Chionoecetes opilio*

Record historic harvests of this stock have occurred since at-sea observer coverage was authorized in 1991. The immense harvests and extended seasons in previous years have generated some of the larger data sets amassed by observers since the program's inception. Over 6 million male and female *C. opilio* crabs have been examined over the last six fishing seasons.

In the 1997 fishery, observers were deployed on 13 catcher-processor and 11 floater-processor vessels. The bycatch sampling goal for observers on catcher-processor vessels was four pots per day fished. Pot contents were sorted and counted by species, sex, and legal size. However, measurements were collected from animals in only one of the four sampled pots due to the large number of crabs per pot routinely taken in this fishery. Concerns over excessive crab mortality on deck while observers are sampling in the extreme weather that occurs during this fishery necessitated subsampling pot contents for carapace measurements. The contents of 1,733 pots were sampled.

Retained biological measurement samples taken from catcher-processors, floater-processors, and shoreside locations had a mean carapace width (CW) of 107.3 millimeters (mm) (Table 1). Approximately 127,800 retained crabs were measured throughout the course of the season. The overall size distribution of retained *C. opilio* has varied slightly over the past seasons. Nearly 40 percent of all retained crabs examined since 1993 have ranged between 106 mm and 115 mm CW (Table 2). The mean carapace width of retained crabs for 1997 is similar to the average from sampled crabs in 1996 (107.5 mm). Although the legal size of C. opilio is stipulated as 3.1 in (79 mm) in regulations, traditionally only males of 4 in (102 mm) CW and larger are desired by processors. In 1996 and 1997, more male crabs of 3.75 in (95 mm) CW and larger were purchased by processors than in previous years (ADF&G Westward Region staff 1998). Over 96% of retained males were classified as new shelled crabs. No soft shelled crabs were encountered in retained crab sampling.

The mean carapace width of all male *C. opilio* measured by observers from bycatch pots, in 1997, was two mm greater than in 1996 (Figure 1). Juvenile crabs below 65 mm CW are not commonly documented in fished pots, which may account, in part, for the somewhat static annual nature of these data.

The abundance of female *C. opilio* in pots sampled during the 1997 fishery was greater than in 1996 and similar to 1994 and 1995. From a total of 1,733 pots examined for contents, 2,402 females were counted and 787 were measured. Histograms depicting the size distribution of *C. opilio* females measured in 1997 show a decreased percentage of new-shelled animals sampled compared to 1996 (Figure 2). Since the 1994 fishery, the mean CW of captured females has not fallen below 66 mm. The occurrence of females observed in sampled pots during the 1997 season increased approximately 250 percent over 1996 (Figure 3).

Retention of illegal crabs was negligible during the 1997 season. Daily legal tally samples taken on catcher-processors, combined with legal measurements collected from catches delivered to floating-processors, produced a total sample of nearly 602,000 retained crabs examined for legal size, sex, and species (Table 3). Approximately 0.3 percent of the sample was comprised of unlawfully retained crabs, most of which were pre-recruit sized (110 to 137 mm) *C. bairdi* males.

Legal *C. opilio* males dominated the catches in bycatch samples, averaging 225 individuals per pot (Figure 3). Catches of incidental species were minor compared to the abundance of legal crabs. *C. bairdi* - *C. opilio* hybrids of mixed sizes and sex constituted the largest portion of incidentally caught crabs. Estimated CPUE, standard error and the total fishery catch for selected crab species during the fishery are also presented (Table 4). Other commercially valuable species observed in bycatch pots included small numbers of *C. bairdi*, Pacific cod (*Gaddus macrocephalus*), and halibut (*Hippoglossus stenolepis*) (Appendix C-1).

Shell age classifications of male *C. opilio* (legal and sublegal crabs) from bycatch sampling were similar to 1994 data (Table 5). Ninety-seven percent of all males examined were classified as new shell, the balance consisting almost exclusively of old-shelled crabs. Very old shelled crabs comprised only 0.2 percent of the samples, a 96 percent decrease from 1996 and similar to the percentage of very old-shelled crabs found in 1994 and 1995.

Female *C. opilio* shell age classification from bycatch sampling in 1997 shows that old and very old-shelled crabs comprise most of the sample (Table 5). In fact, during the 1997 season only two new-shelled females were encountered. The percentage of very old shelled females has increased steadily since the 1994 fishery.

At the time of the 1997 fishery, 41 percent of the *C. opilio* females inspected for signs of mating activity possessed clutches of eyed eggs (Table 6). A very small number (0.6 percent) carried uneyed eggs. All other females were devoid of eggs, with 28 percent described as non-mated. Summarized results of female *C. opilio* reproductive condition assessments during the last several seasons are also given in Table 6.

The locations of bycatch pots sampled in the 1997 Bering Sea *C. opilio* fishery are shown in Appendix B-1. A summary of all animals encountered in observer sampled pots is presented in Appendix C-1.

### *Bering Sea Chionoecetes bairdi (Tanner Crab)*

The Bering Sea *C. bairdi* fishery was completely closed to fishing during the 1997 season because of poor fishery performance in recent years and the low estimated abundance of legal crabs from the annual eastern Bering Sea trawl survey conducted by the National Marine Fisheries Service (Stevens et al., 1997). Published summaries of shellfish observer data collected in the fishery prior to 1997 are available from the Alaska Department of Fish and Game.

### *St. Matthew District Blue King Crab*

A shellfish observer was deployed on one catcher-processor during the 1997 St. Matthew District blue king crab season. Three floater-processors were also in the area to take deliveries from the St. Matthew fishery. The bycatch sampling goal for the observer on the catcher-processor vessel was four pots per day fished. All bycatch sampling data are confidential.

A biological measurement sample of 12,750 retained blue king crabs (taken at all processing locations) had a mean carapace length of 140 mm (Table 7). Over 90 percent of retained sampled crabs were classified as new-shelled. The majority of sampled crabs (68 percent) ranged between 126 mm and 145 mm CL (Table 8). The mean size of sampled retained blue king crabs has increased approximately 5 mm CL over the last four years.

Summaries of pot sample contents from the 1995 and 1997 St. Matthew district blue king crab fisheries are confidential. The shell age composition of male and female blue king crabs from bycatch sampling during the fishery has been well-documented in observer data sets over the past four years (Table 10). In 1996 there was a substantial shift in shell age classification of male and female blue king crabs from new shell to old shell.

Illegally retained crabs encountered during the legal tally sampling of retained animals comprised less than one percent of the total (Table 12). Sub-legal male and female blue king crabs comprised the majority of the illegal crabs retained by vessels sampled by observers.

### *Pribilof District Red and Blue King Crab*

In 1997 the Pribilof district was open concurrently for both red and blue king crab. As no catcher-processors participated, no observers were deployed in the 1997 fishery, precluding any discussion of fishing and biological statistics in this report. Published historical summaries of shellfish observer data collected in this fishery are available from the Alaska Department of Fish and Game.

### *Bristol Bay Area Red King Crab*

The Bristol Bay fishery reopened in 1996 after being closed following the 1993 season due to a critically low estimated abundance of female red king crabs. Data from the 1996 and 1997 fishery are included in this report. Published historical summaries of shellfish observer data collected in this fishery are available from the ADF&G.

Observers were deployed on eight catcher-processor and three floater-processor vessels during the fishery. The bycatch sampling goal for observers on catcher-processor vessels during the 1997 season was three pots per day fished. Crabs were counted and sorted by species, sex, and legal size, and measurements were collected from animals in all three sampled pots. A total of 102 pots were sampled.

Biological measurements of 16,143 retained red king crabs by at-sea observers and ADF&G dockside samplers had a mean carapace length of 153 mm (Table 13). New-shelled crabs represented 88 percent of the retained catch. Seventy-five percent of the sampled crabs ranged between 141 mm and 165 mm (Table 14). The mean carapace length of all male red king crabs (legal and sublegal crabs) measured in sampled pots was 133 mm (Figure 7). Only 68 females were observed and measured from the sampled pots.

Bycatch pot samples were dominated by male red king crabs. Both legal and sublegal males averaged approximately nine crabs per pot. (Figure 8). Compared to the 1996 season, the catch of legal males decreased 32% and the catch of sublegal males increased 27% in the 1997 season. Females were evident at a rate of 0.8 per pot. Combined sizes and sexes of *C. bairdi* averaged 2.4 per pot. Estimates of CPUE, standard errors and the total catch for selected species are presented in Table 15. Other species present in the sampled pots are shown in Appendix C-3.

Shell age conditions of sampled crabs indicated that 88 percent of the males and all 68 females were new shell (Table 16). The remainder of the males were categorized as old or very old. Fifty-nine (86%) of the females were gravid and the majority of the clutches examined contained eyed eggs (Table 17).

Illegally retained crabs encountered during random legal tally sampling of retained animals comprised less than one percent of the total (Table 18). Over 39,000 crabs were sampled from both catcher-processors and deliveries to floater-processors. Sub-legal red king crab males comprised the majority of the illegally retained crabs at 0.47%.

Locations of bycatch pots sampled in the 1997 Bristol Bay red king crab fishery are shown in Appendix B-3.

### *Aleutian Islands Brown King Crab*

In March of 1996, the Alaska Board of Fisheries established the Aleutian Islands king crab registration area by combining two existing areas, Dutch Harbor and Adak. The board established September 1 as the opening date for the new area, and closure would be by emergency order instead of a regulatory date. The board also stipulated that 100% observer coverage would be maintained in this fishery for the present time (ADF&G, Westward Region staff, 1998). Published summaries of shellfish observer data collected in the Dutch Harbor and Adak brown king crab fisheries prior to 1996/1997 season are available from the Alaska Department of Fish and Game.

Data compiled in this report encompasses a 12 month period in which the fishery occurred, beginning September 1, 1996 and concluding on August 31, 1997. Fishing activity occurred during every month of the season. The bycatch sampling goals given observers varied depending

upon the type of pots fished. A minimum of eight pots were sampled each day if the vessel was fishing rectangular pots and a minimum of 12 pots per day were sampled if smaller, conical pots were fished. At the conclusion of the 1996/1997 season, two catcher-processors and 16 catcher-only vessels had participated in the fishery. Data was collected from the contents of 12,022 sampled pots.

The mean CL of the 33,204 retained male crabs measured by observers was 147 mm (Table 19). Ninety-six percent of retained crabs sampled were new shell. Seventy-six percent of the crabs sampled ranged between 136 and 150 mm CL (Table 20).

The mean carapace length of all males in sampled pots was 130 mm CL (Figure 9). Eighty-eight juvenile male crabs less than 50 mm CL occurred as bycatch in sampled pots; fifteen mature male crabs exceeding 190 mm CL were also documented. The mean size of sampled female brown king crabs was 122 mm CL (Figure 9).

Unlawfully retained crabs consisted entirely of undersized male and female brown king crabs (Table 21). Over 177,000 retained crabs were examined during legal tally sampling, which accounted for approximately 13.2% of the total 1996/1997 harvest of brown king. Illegal crab accounted for less than one percent of the sample.

Data was collected over the entire geographic area where fishing effort occurs and from every month during the year-long season (Appendix B-4). The species composition of pots sampled in the Aleutian Island fishery includes a wide variety of invertebrate and fish species. However, brown king crab females and sub-legal males were predominant in the incidental catch. During the 1996/1997 season, the mean catch per pot of legal males was six. (Figure 10). Catches of female and undersized male brown king crabs averaged 10 and nine animals per pot, respectively. Estimated CPUE, standard error and total fishery catch of brown king crab based on sampled pots are presented in Table 22. A summary of all animals encountered in observer sampled pots is presented in Appendix C-4.

Results from bycatch sampling showed that about 98 percent of male crabs and 97 percent of female crabs examined were characterized as new-shelled (Table 23). Observers have reported the periodic occurrence of very old, large brown king males described as having discolored, highly abraded shells with a soft, "leathery" texture. These crabs comprise a negligible portion of bycatch samples.

Ovigerous crabs accounted for 46 percent of the 126,524 brown king females assessed for signs of reproductive activity (Table 24). Approximately one of every three females observed was barren with no evidence of prior mating.

A single catcher-only vessel targeted *Lithodes couesi* in the Aleutian Islands registration area while fishing for brown king crab. Information derived from this fishing activity is confidential.

### *Bering Sea Korean Hair Crab*

Prior to the 1992 Bering Sea Korean hair crab fishery, ADF&G included observer coverage as a permit requirement for all participants. A general lack of established life history and other biological knowledge of Korean hair crabs and concerns over possible excessive red king crab

and *C. bairdi* bycatch prompted the observer coverage. Legislation enacted by the Alaska legislature in 1996 placed a four year moratorium on the entry of additional vessels into this fishery which occurs outside of five miles from shore.

Observers were deployed on 16 catcher-only vessels in 1997. Catcher-processor and floater-processor vessels did not participate in the fishery. Vessels targeting Korean hair crabs typically deploy large numbers of pots on a daily basis. In order to obtain representative catch composition statistics from the 1997 fishery, individual observers were directed to examine a total of 30 pots per day of fishing activity. Size measurements and other biological data were collected from the animals in 10 of the sampled pots; the remaining 20 pots were sampled for species composition, sex, and legal status. Observers sampled crabs in 5,463 bycatch pots, approximately 3,000 pots less than the number of pots sampled in 1996.

A total of 4,259 retained biological measurements had a mean carapace length of 95 mm for retained males (Table 25). Crabs landed in the 1994, 1995, and 1996 seasons were somewhat smaller than those observed in 1997; mean sizes ranged from 91 mm to 93 mm CL between the respective seasons (Table 26).

The carapace lengths of more than 5,000 measured male Korean hair crabs (legal and sub-legal) observed in bycatch samples showed little variation from the size distribution of the retained catch. The average size of all sampled male crabs was 93 mm CL. (Figure 11). The catch of male crabs larger than 110 mm CL has been rare in all years.

Only 191 female Korean hair crabs were measured from bycatch pots during the 1997 fishery. Sizes ranged from 35 mm to 91 mm CL, although length frequencies predominantly ranged within a 58 mm to 82 mm interval (Figure 12). Females averaged 69 mm CL in 1997, 2 mm CL larger than the mean-sized female observed in 1996.

A summary of bycatch samples show that legal Korean hair crabs were landed more frequently than all other crab species (Figure 13). Red king crabs of mixed sizes and sex were the next largest component of the catch in sampled pots. Mean pot catches of legal male Korean hair crab for the 1997 season (at 2.3 crabs per pot) is greater than in 1996, but still below the average catch of 3 crabs per pot during the 1994 and 1995 fisheries. Estimated CPUE, standard error and total fishery catch of Korean hair crab is presented in Table 27. A summary of all animals encountered in observer sampled pots is presented in Appendix C-5.

Classification of male Korean hair crab shell condition was similar to shell age composition found in sampled catches in 1994 and 1995 (Table 28). Approximately 85 percent of male Korean hair crabs sampled were characterized as new-shelled. The majority of females (92 percent) were also described as new shell (Table 28). The incidence of a large proportion of Korean hair crab with the extensive barnacle growth evident in 1996 was not seen in the 1997 fishery.

Of the 195 female Korean hair crabs examined for reproductive activity during the fishery only nine were ovigerous. Females described as non-mated comprised the largest portion of the sample at 59 percent (Table 29).

Results of observer legal tally sampling on catcher-only vessels indicated that a relatively small number of under-sized male and female Korean hair crabs were harvested. Just over 27,000 crabs were inspected, which amounted to 6.4 percent of the total retained catch in 1997 (Table 30). Prohibited crabs comprised less than one percent of the crabs sampled, the majority of which were sub-legal male hair crabs.

Locations of bycatch pots sampled in the 1997 Bering Sea Korean hair crab fishery are shown in Appendix B-5.

### *Chionoecetes tanneri and Chionoecetes angulatus*

Significant commercial interest in marketing *C. tanneri* (commonly referred to as "grooved Tanner crab") and *C. angulatus* (commonly referred to as "triangle Tanner crab") had resulted in directed fishing effort in the Bering Sea, Aleutian Islands, and South (Alaska) Peninsula registration areas prior to 1997. As a result of this interest, in February of 1997 ADF&G set guideline harvest levels (GHL) for the *C. tanneri* fisheries in the Kodiak, South Peninsula, Eastern Aleutians, Western Aleutians, and Bering Sea areas. Harvest levels were derived from previous season catch information in areas where extensive fishing activity had occurred (ADF&G Westward region staff, 1998). Prior to 1995 *C. angulatus* had been harvested as incidental bycatch in the *C. tanneri* fisheries and no harvest was reported on fish tickets. Vessels targeted *C. angulatus* for the first time in 1995 although there has since been no GHL established for this species.

Little is known of the life history and population dynamics of these previously unexploited stocks. In order to establish a baseline archive of biological data and to initiate research activities aimed at enhancing fisheries management, ADF&G mandated observer coverage on all vessels that had targeted *C. tanneri* and *C. angulatus* in Alaskan waters prior to the 1994 fisheries. All *C. tanneri* and *C. angulatus* fisheries have been conducted as permit fisheries with a year-round season.

No vessels registered to harvest *C. tanneri* or *C. angulatus* during the 1997 calendar year. Published summaries of shellfish observer data collected in these fisheries prior to 1997 are available from the Alaska Department of Fish and Game.

### *Bering Sea Snails*

Concerns over possible excessive crab bycatch prompted ADF&G to require observers on all vessels fishing for snails west of 164 degrees west longitude and north of 54 degrees, 36 minutes north latitude in the Bering Sea. Two catcher-only vessels obtained shellfish observers and targeted snails in 1997. The sample goal for observers was to sample one pot out of every 50 pots lifted or ten pots per day fished, whichever was greater. Information derived from observer bycatch pot samples is confidential.

### *Accuracy and Precision of CPUE Estimates*

In using CPUE estimates based on observer data it is important to have some assessment of their reliability in estimating the catch rates for observed vessels and, especially, for all vessels participating in a fishery. Although the observer data is the only source of information on bycatch rates in the fisheries presented in this report, confidential interviews with the operators of observed vessels and fish tickets provide data for independent estimates of the CPUE of retained legal crabs. We can gain some understanding of the reliability of the CPUE estimates computed from observer data by comparing the retained legal CPUE estimates computed from observer data with those computed from confidential interview and fish ticket data.

The confidential interview data provides estimates of retained legal CPUE for the observed vessels participating in a fishery. Accordingly, in this discussion we will refer to the retained legal CPUE estimated from confidential interview data as the 'Actual Observed Fleet CPUE' (AOF CPUE). Note that in those fisheries for which 100% observer coverage was required (i.e., the Bering Sea Korean hair crab fishery and the Aleutian Islands brown king crab fishery), the AOF CPUE also provides an independent retained legal CPUE estimate for the entire fishery. Fish ticket data from all landings of all vessels participating in a fishery provide an independent estimate of the total fishery CPUE of retained legal crabs for a fishery in which observers were required only on catcher-processor vessels (C/Ps). We will refer to the CPUE of retained legal crabs estimated from the fish ticket data for all fishery landings as the "Actual Total Fishery CPUE' (ATF CPUE).

CPUE estimates computed from observer data for retained legal crabs are within 9% or less than 1 crab per pot of the AOF CPUE for the St. Matthew District blue king crab, Aleutian Islands brown king crab, and the Bering Sea Korean hair crab fisheries (Table 31). The close agreement between the observer-based and AOF CPUE estimates for retained legal crab in each of those three fisheries indicates that observer data provides highly reliable estimates of CPUE for the observed portion of the fleet in each of those fisheries. The close agreement between those two CPUE estimates also indicates that observer data provides reliable CPUE estimates for the entire fishery in the Aleutian Islands brown king crab and the Korean hair crab fisheries, because observer coverage was 100% in each of those fisheries.

CPUE estimates computed from observer data for retained legal crabs in the Bering Sea *C. opilio* and the Bristol Bay red king crab fisheries differed from the AOF CPUE by four crabs per pot or greater, indicating lower reliability of observer data in providing catch rate estimates for the observed fleets in those fisheries (Table 31). Those two fisheries are characterized by the highest catcher-vessel participation of any Westward Region shellfish fishery. In the *C. opilio* fishery the observer-based estimate of CPUE differed from the confidential interviews estimate by more than 13%, or 21 crabs per pot, but was within 1% of the fish ticket estimate. This discrepancy suggests a possible bias in the confidential interviews. Since the CPUE of legal *C. opilio* crabs is high compared to other fisheries it is difficult to keep accurate count of all crabs deposited in the live hold. Observers report that crew members tend to over-estimate the number of crabs retained from each pot. This number is then passed on to the vessel operator for his records. The summary of these estimates is what is the captain uses to complete confidential interviews.

The estimated CPUE for legal retained males using observer data from the Bristol Bay red king crab fishery is problematic. The relative difference between the estimated CPUE and the AOF CPUE of 28% is based on an absolute difference of nearly 5 crabs per pot (9.7 vs 13.5, Table 15). There was also a large discrepancy between the observer-based estimate and the ATF CPUE (9.7 vs 14.5). A possible explanation for the lack of agreement between the estimates is that the 102 pots sampled by observers were not enough to capture the variability of the overall catch from the 8 C/Ps which participated in this fishery. Additionally, since observers were deployed only on C/Ps, the difference in estimates may be due to differences in fishing performance between the C/P and the catcher-only vessel portions of the fleet participating in this fishery.

Comparison of CPUE estimates based on observer data for retained legal crabs with the ATF CPUE in the other fishery with partial observer coverage (Table 31) indicates that partial observer coverage provided adequate data for estimation of CPUE for the entire fishery in the St. Matthew District blue king crab fishery. It is noteworthy that observers deployed only on the one catcher-processor participating in that fishery and sampling only 43 pots provided adequate data to accurately (within 9%) estimate the retained legal CPUE for the entire fishery.

The most accurate CPUE estimates were for the Aleutian Islands brown king crab fishery, in which the observer-based CPUE estimate differed from the AOF CPUE by less than 4% (0.2 crab per pot). In comparison, CPUE estimates for the 1994-95 Adak brown king crab fishery differed from ATF CPUE estimates by more than 37% in a fishery with partial (C/Ps only) observer coverage (Boyle et al., 1996). That fishery had observers deployed on only 12% of the vessels participating. Observer coverage was increased to 100% coverage for the 1995-96 fishery.

The 'stratified' observer-based CPUE estimator used in this report is different from the 'sample' observer-based CPUE estimate used in past Mandatory Shellfish Observer Database Summaries (e.g., Tracy 1994, 1995a,b). Although the stratified estimation method can provide more accurate and precise estimates, the stratified and sample CPUE estimates are generally very close to each other. Therefore the stratified estimates presented here are comparable to those CPUE estimates included in previous observer data summaries. The value of using the stratified CPUE estimates is that the estimation method allows for computation of the standard errors of the CPUE estimates.

The standard errors provided in this report give a measure of the precision or repeatability of the CPUE estimates. Generally, the stratified CPUE estimates appear to be precise, as reflected in the relatively small standard errors. We did not compute confidence intervals for the CPUE estimates as the sample size within each stratum (vessel-day) was not large enough to assume an asymptotic normal distribution. However, bootstrap simulation of observer data collected in the 1995 Bering Sea and Aleutian Islands crab fisheries suggests that the stratified CPUE estimates plus or minus two standard errors was adequate to characterize the true CPUE of the targeted species (Byrne and Pengilly 1998).

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Table 1. Mean carapace width and shell age statistics derived from retained biological measurements of *Chionoecetes opilio* during the 1997 Bering Sea *C. opilio* fishery.

| Sample Type | Sample Size | Mean Width | Shell Age (%) | | | |
|---|---|---|---|---|---|---|
| | | | Soft | New | Old | Very Old |
| Catcher Processor | 55,642 | 107.4 mm | 0.00 | 97.88 | 2.08 | 0.04 |
| Floating Processor | 45,241 | 106.9 mm | 0.00 | 95.61 | 4.20 | 0.18 |
| Shoreside Processor | 26,935 | 107.9 mm | 0.00 | 95.26 | 4.54 | 0.20 |
| Totals | 127,818 | 107.3 mm | 0.00 | 96.53 | 3.35 | 0.12 |

Table 2. Carapace width frequencies derived from retained biological measurements of *Chionoecetes opilio* during the 1994-1997 Bering Sea *C. opilio* fisheries.

| | 1994 | | 1995 | | 1996 | | 1997 | |
|---|---|---|---|---|---|---|---|---|
| Width (mm) | Num. Crab | Percent | Num. Crab | Percent | Num. Crab | Percent | Num. Crab | Percent |
| 86-90 | 1,590 | 0.92 | 1,655 | 1.57 | 1,991 | 2.04 | 897 | 0.69 |
| 91-95 | 4,333 | 2.50 | 4,713 | 4.46 | 5,058 | 5.21 | 3,848 | 3.00 |
| 96-100 | 13,435 | 7.75 | 11,784 | 11.14 | 12,073 | 12.44 | 16,168 | 12.64 |
| 101-105 | 29,095 | 16.79 | 20,050 | 18.96 | 19,803 | 20.42 | 34,763 | 27.20 |
| 106-110 | 37,902 | 21.87 | 21,442 | 20.29 | 20,572 | 21.20 | 32,027 | 25.05 |
| 111-115 | 37,157 | 21.44 | 18,824 | 17.80 | 17,018 | 17.54 | 21,544 | 16.86 |
| 116-120 | 27,721 | 16.00 | 13,817 | 13.06 | 11,317 | 11.67 | 11,487 | 8.98 |
| 121-125 | 14,512 | 8.36 | 8,006 | 7.57 | 5,620 | 5.78 | 4,905 | 3.83 |
| 126-130 | 5,127 | 2.96 | 3,062 | 2.90 | 1,822 | 1.87 | 1,459 | 1.13 |
| 131-135 | 1,080 | 0.62 | 756 | 0.72 | 400 | 0.40 | 281 | 0.21 |
| Totals | 171,952 | 99.21 | 104,109 | 98.47 | 95,674 | 98.57 | 127,379 | 99.59 |
| | Mean width = 110.4 mm | | Mean width = 110.0 mm | | Mean width = 107.5 mm | | Mean width = 107.3 mm | |

Table 3. Summary of illegally retained crabs from the legal tally sample during the 1997 Bering Sea *Chionoecetes opilio* fishery.

| Sample Location | Sample Size | Male | | Female | | Other Crabs | Total Percent Illegal | Number Crabs Harvested[a] | Estimated Number Illegal Crabs | Percent Harvest Sampled |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | | | | | |
| Catcher Processor | 332,450 | 327 | 0.10 | 43 | 0.01 | 665 | 0.31 | 10,631,629 | 33,099 | 3.13 |
| Floating Processor | 269,273 | 199 | 0.07 | 73 | 0.03 | 799 | 0.40 | 50,429,597 | 200,577 | 0.53 |
| Totals[b] | 601,723 | 526 | 0.09 | 116 | 0.02 | 1,464 | 0.35 | 61,061,226 | 233,676 | 0.99 |

[a] ADF&G, Westward Region staff 1998.

[b] Represents only vessels sampled by observers.

Table 4. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on catcher-processors during the 1997 Bering Sea *Chionoecetes opilio* fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 1,695 pot lifts sampled from all 13 catcher-processors that participated in the fishery.

| Species / Sex Class | Total Pot Sample Catch | Estimated CPUE For Sampled Fleet | Estimated Total Fishery Catch [a] |
|---|---|---|---|
| *opilio* Tanner crab | | | |
| retained males | 238,501 | 133.92 (1.79)[b] | 100,910,000[c] |
| legal males | 390,028 | 225.87 (2.98) | 170,193,000 |
| sublegal males | 8,387 | 4.96 (0.26) | 3,737,000 |
| females | 2,408 | 1.35 (0.38) | 1,020,000 |
| *bairdi* Tanner crab | | | |
| legal males | 553 | 0.33 [d] | 250,000 |
| sublegal males | 8,446 | 4.77 (0.27) | 3,600,000 |
| females | 1,515 | 0.89 [d] | 670,000 |
| *opilio x bairdi* hybrid | | | |
| legal males | 20,878 | 10.44 (0.36) | 7,870,000 |
| sublegal males | 1,726 | 0.90 (0.18) | 680,000 |
| females | 218 | 0.13 [d] | 98,000 |

[a] Estimated CPUE multiplied by 753,636 total pot lifts (ADF&G, Westward Region staff 1998) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 154.9 for observed vessels; actual total fishery CPUE of retained legal crabs was 132.6 for all vessels (ADF&G, Westward Region staff 1998).

[c] Actual catch of retained legal crabs for the fishery was 99,899,744 (ADF&G, Westward Region staff 1998).

[d] CPUE computed as total pot sample catch divided by 1,695 pots sampled; standard errors of estimates were not computed

Table 5. Shell age statistics for *Chionoecetes opilio* males and females observed in bycatch samples during the Bering Sea *C. opilio* fisheries, 1994 - 1997.

| Fishery Year | Sample Size | Shell Age Classes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Soft | %Total | New | %Total | Old | %Total | Very Old | %Total |
| **1994** | | | | | | | | | |
| Males | 167,447 | 4 | < 0.01 | 156,555 | 93.50 | 9,942 | 5.94 | 946 | 0.56 |
| Females | 1,273 | 0 | 0 | 62 | 4.87 | 929 | 72.98 | 282 | 22.15 |
| **1995** | | | | | | | | | |
| Males | 77,302 | 2 | < 0.01 | 68,596 | 88.74 | 8,083 | 10.46 | 621 | 0.80 |
| Females | 539 | 0 | 0 | 74 | 13.73 | 328 | 60.85 | 137 | 25.42 |
| **1996** | | | | | | | | | |
| Males | 76,028 | 46 | 0 | 54,249 | 71.35 | 18,163 | 23.89 | 3,570 | 4.70 |
| Females | 136 | 0 | 0 | 49 | 36.03 | 46 | 33.82 | 41 | 30.15 |
| **1997** | | | | | | | | | |
| Males | 128,429 | 1 | < 0.01 | 125,086 | 97.40 | 3,123 | 2.43 | 219 | 0.17 |
| Females | 787 | 0 | 0 | 2 | 0.25 | 466 | 59.21 | 319 | 40.53 |

Table 6. Summary of the reproductive status of female *Chionoecetes opilio* observed in bycatch samples during the 1994 - 1997 Bering Sea *C. opilio* fisheries.

| Year | Eyed Eggs | Percent Total | Uneyed Eggs | Percent Total | Barren, Mated | Percent Total | Barren, Non-mated | Percent Total |
|---|---|---|---|---|---|---|---|---|
| 1994 | 800 | 64.05 | 60 | 4.80 | 116 | 9.29 | 273 | 21.86 |
| 1995 | 340 | 80.38 | 53 | 12.53 | 26 | 6.15 | 4 | 0.95 |
| 1996 | 81 | 59.56 | 5 | 3.68 | 22 | 16.18 | 28 | 20.59 |
| 1997 | 323 | 40.94 | 5 | 0.63 | 240 | 30.42 | 221 | 28.01 |
| Totals | 1,544 | 59.45 | 123 | 4.74 | 404 | 15.56 | 526 | 20.25 |

Table 7. Mean carapace length and shell age statistics derived from retained biological measurements of blue king crab during the 1997 St. Matthew District blue king crab fishery.

| Sample Type | Sample Size | Mean Length | Shell Age (%) | | | |
|---|---|---|---|---|---|---|
| | | | Soft | New | Old | Very Old |
| Catcher Processor | | CONFIDENTIAL | | | | |
| Floating Processor | 6,848 | 139.1 mm | 0.00 | 85.57 | 14.31 | 0.11 |
| Shoreside Processor | 5,110 | 140.8 mm | 0.00 | 95.63 | 4.24 | 0.11 |
| Totals | | CONFIDENTIAL | | | | |

Table 8. Carapace length frequencies derived from retained biological measurements of blue king crab during the 1994-1997 St. Matthew District blue king crab fisheries.

| | 1994 | | 1995 | | 1996 | | 1997 | |
|---|---|---|---|---|---|---|---|---|
| Length (mm) | Num. Crab | Percent | Num. Crab | Percent | Num. Crab | Percent | Num. Crab | Percent |
| 111-115 | 15 | 0.12 | 10 | 0.14 | 2 | 0.04 | 1 | 0.01 |
| 116-120 | 315 | 2.80 | 161 | 2.21 | 163 | 3.18 | 107 | 0.83 |
| 121-125 | 1,445 | 12.89 | 762 | 10.44 | 653 | 12.72 | 723 | 5.67 |
| 126-130 | 2,505 | 22.35 | 1,315 | 18.04 | 886 | 17.27 | 1,620 | 12.71 |
| 131-135 | 2,735 | 24.39 | 1,681 | 23.05 | 1,120 | 21.82 | 2,422 | 19.00 |
| 136-140 | 2,209 | 19.70 | 1,540 | 21.06 | 1,019 | 19.86 | 2,501 | 19.62 |
| 141-145 | 1,228 | 10.96 | 1,074 | 14.72 | 717 | 13.97 | 2,192 | 17.19 |
| 146-150 | 533 | 4.76 | 543 | 7.44 | 394 | 7.67 | 1,444 | 11.32 |
| 151-155 | 147 | 1.30 | 154 | 2.10 | 128 | 2.50 | 812 | 6.36 |
| 156-160 | 48 | 0.43 | 49 | 0.67 | 36 | 0.69 | 453 | 3.54 |
| Totals | 11,180 | 99.70 | 7,289 | 99.87 | 5,118 | 99.68 | 12,275 | 96.24 |
| | Mean Length = | 133.3 mm | Mean Length = | 134.8 mm | Mean Length = | 134.6 mm | Mean Length = | 139.5 mm |

Table 9. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on catcher-processors during the 1997 St. Matthew District blue king crab fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from one catcher processor that participated in the fishery.

| Species / Sex Class | Total Pot Sample Catch | Estimated CPUE For Sampled Fleet | Estimated Total Fishery Catch [a] |
|---|---|---|---|
| Blue king crab | | | |
| legal males | | | |
| sublegal males | | | |
| females | | CONFIDENTIAL | |
| *opilio* Tanner crab | | | |
| legal males | | | |
| sublegal males | | | |
| females | | | |

[a] Estimated CPUE multiplied by 81,117 total pot lifts (ADF&G, Westward Region staff 1998) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was (confidential) for observed vessels; actual total fishery CPUE of retained legal crabs was 11.6 for all vessels (ADF&G, Westward Region staff 1998).

[c] Actual catch of retained legal crabs for the fishery was 939,822 (ADF&G, Westward Region staff 1998).

[d] CPUE computed as total pot sample catch divided by (confidential) pots sampled; standard errors of estimates were not computed.

Table 10. Shell age statistics for blue king crab males and females observed in bycatch samples during the St. Matthew District blue king crab fisheries, 1994 - 1997.

| Fishery Year | Sample Size | Shell Age Classes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Soft | %Total | New | %Total | Old | %Total | Very Old | %Total |
| **1994** | | | | | | | | | |
| Males | 6,054 | 4 | 0.07 | 5,960 | 98.45 | 90 | 1.49 | 0 | 0.00 |
| Females | 5,107 | 0 | 0.00 | 4,285 | 83.90 | 818 | 16.02 | 4 | 0.08 |
| **1995** | | | | | | | | | |
| Males | | | CONFIDENTIAL | | | | | | |
| Females | | | | | | | | | |
| **1996** | | | | | | | | | |
| Males | 555 | 0 | 0.00 | 305 | 54.95 | 238 | 42.88 | 12 | 2.16 |
| Females | 233 | 0 | 0.00 | 58 | 24.89 | 163 | 69.96 | 12 | 5.15 |
| **1997** | | | | | | | | | |
| Males | | | CONFIDENTIAL | | | | | | |
| Females | | | | | | | | | |

Table 11. Summary of the reproductive status of female blue king crab observed in bycatch samples during the 1994 - 1997 St. Matthew District blue king crab fisheries.

| Year | Eyed Eggs | Percent Total | Uneyed Eggs | Percent Total | Barren, Mated | Percent Total | Barren, Non-mated | Percent Total |
|---|---|---|---|---|---|---|---|---|
| 1994 | 0 | 0.00 | 2 | 0.04 | 3,443 | 67.43 | 1,661 | 32.53 |
| 1995 | | | CONFIDENTIAL | | | | | |
| 1996 | 0 | 0.00 | 0 | 0.00 | 165 | 70.82 | 68 | 29.18 |
| 1997 | | | CONFIDENTIAL | | | | | |
| Totals | 2 | 0.03 | 3 | 0.05 | 4,583 | 69.40 | 2,016 | 30.53 |

Table 12. Summary of illegally retained crabs from the legal tally sample during the 1997 St. Matthew District blue king crab fishery.

| Sample Location | Sample Size | Male | | Female | | Other Crabs | Total Percent Illegal | Number Crabs Harvested[a] | Estimated Number Illegal Crabs | Percent Harvest Sampled |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | | | | | |
| Catcher Processor | CONFIDENTIAL | | | | | | | | | |
| Floating Processor | 45,305 | 98 | 0.22 | 82 | 0.18 | 24 | 0.45 | 595,923 | 2,683 | 7.60 |
| Totals[b] | CONFIDENTIAL | | | | | | | | | |

[a] ADF&G, Westward Region staff 1998

[b] Represents only vessels sampled by observers.

Table 13. Mean carapace length and shell age statistics derived from retained biological measurements of red king crabs during the 1997 Bristol Bay red king crab fishery.

| Sample Type | Sample Size | Mean Length | Shell Age (%) | | | |
|---|---|---|---|---|---|---|
| | | | Soft | New | Old | Very Old |
| Catcher Processor | 2,854 | 152.1mm | 0.00 | 84.61 | 13.38 | 1.99 |
| Floating Processor | 4,923 | 153.5mm | 0.00 | 88.82 | 10.76 | 0.40 |
| Shoreside Processor | 8,366 | 152.0mm | 0.00 | 90.76 | 8.03 | 1.20 |
| Totals | 16,143 | 152.5mm | 0.00 | 89.08 | 9.81 | 1.10 |

Table 14. Carapace length frequencies derived from retained biological measurements of red king crab during Bering Sea red king crab fisheries, 1996 - 1997.

| | 1996 | | 1997 | |
|---|---|---|---|---|
| Length (mm) | Num. Crab | Percent | Num. Crab | Percent |
| 131-135 | 201 | 2.26 | 407 | 2.52 |
| 136-140 | 842 | 9.46 | 1,732 | 10.73 |
| 141-145 | 1,302 | 14.64 | 2,443 | 15.13 |
| 146-150 | 1,511 | 16.99 | 2,613 | 16.19 |
| 151-155 | 1,572 | 17.67 | 2,738 | 16.96 |
| 156-160 | 1,427 | 16.04 | 2,511 | 15.55 |
| 161-165 | 1,049 | 11.79 | 1,839 | 11.39 |
| 165-170 | 591 | 6.64 | 1,169 | 7.24 |
| 171-175 | 266 | 2.99 | 474 | 2.94 |
| 176-180 | 90 | 1.01 | 158 | 0.98 |
| Totals | 8,851 | 99.49 | 16,084 | 97.11 |
| | Mean Length = | 152.6 mm | Mean Length = | 152.5 mm |

Table 15. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on catcher-processors during the 1997 Bristol Bay red king crab fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 102 pot lifts sampled from all 8 catcher-processors that participated in the fishery.

| Species / Sex Class | Total Pot Sample Catch | Estimated CPUE For Sampled Fleet | Estimated Total Fishery Catch [a] |
|---|---|---|---|
| Red king crab | | | |
| legal males | 945 | 9.73 (1.10) [b] | 880,000 [c] |
| sublegal males | 971 | 10.04 (2.18) | 910,000 |
| females | 85 | 0.83 [d] | 75,000 |
| *bairdi* Tanner crab | | | |
| legal males | 160 | 1.49 (0.19) | 135,000 |
| sublegal males | 73 | 0.72 [d] | 65,000 |
| females | 10 | 0.10 [d] | 8,900 |

[a] Estimated CPUE multiplied by 90,510 total pot lifts (ADF&G, Westward Region staff 1998) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 13.5 for observed vessels; actual total fishery CPUE of retained legal crabs was 14.5 for all vessels (ADF&G, Westward Region staff 1998).

[c] Actual catch of retained legal crabs for the fishery was 1,315,969 (ADF&G, Westward Region staff 1998).

[d] CPUE computed as total pot sample catch divided by 102 pots sampled; standard errors of estimates were not computed.

Table 16. Shell age statistics for red king crab males and females observed in bycatch samples during Bering Sea red king crab fisheries, 1996 -1997.

| Fishery Year | Sample Size | Shell Age Classes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Soft | %Total | New | %Total | Old | %Total | Very Old | %Total |
| **1996** | | | | | | | | | |
| Males | 642 | 0 | 0.00 | 539 | 83.96 | 97 | 15.11 | 6 | 0.93 |
| Females | 11 | 0 | 0.00 | 11 | 100.00 | 0 | 0.00 | 0 | 0.00 |
| **1997** | | | | | | | | | |
| Males | 1,787 | 0 | 0.00 | 1,580 | 88.42 | 190 | 10.63 | 17 | 0.95 |
| Females | 68 | 0 | 0.00 | 68 | 100.00 | 0 | 0.00 | 0 | 0.00 |

Table 17. Summary of the reproductive status of female red king crabs observed in bycatch samples during the Bristol Bay red king crab fisheries, 1996 - 1997.

| Year | Eyed Eggs | Percent Total | Uneyed Eggs | Percent Total | Barren, Mated | Percent Total | Barren, Non-mated | Percent Total |
|---|---|---|---|---|---|---|---|---|
| 1996 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 11 | 100.00 |
| 1997 | 46 | 65.71 | 13 | 18.57 | 0 | 0.00 | 11 | 15.71 |
| Totals | 46 | 56.79 | 13 | 16.05 | 0 | 0.00 | 22 | 27.16 |

Table 18. Summary of illegally retained crabs from the legal tally sample during the 1997 Bristol Bay red king crab fishery.

| Sample Location | Sample Size | Male | | Female | | Other Crabs | Total Percent Illegal | Number Crabs Harvested[a] | Estimated Number Illegal Crabs | Percent Harvest Sampled |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | | | | | |
| Catcher Processor | 10,863 | 99 | 0.91 | 5 | 0.05 | 5 | 1.00 | 45,034 | 452 | 24.12 |
| Floating Processor | 28,863 | 86 | 0.30 | 1 | 0.00 | 0 | 0.30 | 1,558,734 | 4698 | 1.85 |
| Totals[b] | 39,726 | 185 | 0.47 | 6 | 0.02 | 5 | 0.49 | 1,603,768 | 5,150 | 2.48 |

[a] ADF&G Westward region staff 1998.

[b] Represents only vessels sampled by observers.

Table 19. Mean carapace length and shell age statistics derived from retained biological measurements of brown king crab during the 1996/1997 Aleutian Islands brown king crab fishery.

| Sample Type | Sample Size | Mean Length | Shell Age (%) | | | |
|---|---|---|---|---|---|---|
| | | | Soft | New | Old | Very Old |
| Catcher Processor | | CONFIDENTIAL | | | | |
| Catcher Vessel | 9,125 | 147.8 mm | 0.04 | 95.79 | 3.89 | 0.27 |
| Totals | | CONFIDENTIAL | | | | |

Table 20. Carapace length frequencies derived from retained biological measurements of brown king crab during the 1996/1997 Aleutian Islands brown king crab fishery.

| | 1997 | |
|---|---|---|
| Length (mm) | Num. Crab | Percent |
| 116-120 | 8 | 0.01 |
| 121-125 | 13 | 0.03 |
| 126-130 | 124 | 0.37 |
| 131-135 | 2,161 | 6.51 |
| 136-140 | 6,848 | 20.62 |
| 141-145 | 7,759 | 23.37 |
| 146-150 | 6,304 | 18.98 |
| 151-155 | 4,188 | 12.60 |
| 156-160 | 2,539 | 7.65 |
| 161-165 | 1,585 | 4.76 |
| 166-170 | 945 | 2.84 |
| 171-175 | 450 | 1.36 |
| Totals | 32,924 | 99.10 |
| | Mean Length = | 147.0 mm |

Table 21. Summary of illegally retained crabs from the legal tally sample during the 1996/1997 Aleutian Islands brown king crab fishery.

| Sample Location | Sample Size | Male | | Female | | Other Crabs | Total Percent Illegal | Number Crabs Harvested[a] | Estimated Number Illegal Crabs | Percent Harvest Sampled |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | | | | | |
| Catcher Processor | CONFIDENTIAL | | | | | | | | | |
| Catcher Vessel | 64,051 | 693 | 1.08 | 43 | 0.07 | 0 | 1.15 | 1,076,081 | 12,365 | 5.95 |
| Totals | CONFIDENTIAL | | | | | | | | | |

[a] ADF&G, Westward region staff 1998.

Table 22. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on catcher-processors and catcher vessels during the 1997 Aleutian Islands brown king crab fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 12,020 pot lifts sampled from all 18 catcher-processors and catcher vessels that participated in the fishery.

| Species / Sex Class | Total Pot Sample Catch | Estimated CPUE For Sampled Fleet | Estimated Total Fishery Catch [a] |
|---|---|---|---|
| Brown king crab | | | |
| legal males | 68,798 | 5.98 (0.07) [b] | 1,280,000 [c] |
| sublegal males | 107,685 | 9.31 (0.16) | 1,990,000 |
| females | 126,784 | 10.99 (0.25) | 2,350,000 |
| Scarlet king crab | | | |
| legal males | 680 | 0.06 [d] | 12,100 |
| sublegal males | 107 | <0.01 [d] | 1,900 |
| females | 153 | 0.01 [d] | 2,600 |

[a] Estimated CPUE multiplied by 213,800 total pot lifts (ADF&G, Westward Region staff 1998) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 6.2 for observed vessels; actual total fishery CPUE of retained legal crabs was 6.3 for all vessels (ADF&G, Westward Region staff 19978).

[c] Actual catch of retained legal crabs for the fishery was 1,343,950 (ADF&G, Westward Region staff 1998).

[d] CPUE computed as total pot sample catch divided by 12,020 pots sampled; standard errors of estimates were not computed.

Table 23. Shell age statistics for brown king crab males and females observed in bycatch samples during the 1997 Aleutian Islands brown king crab fishery.

| Fishery Year | Sample Size | Shell Age Classes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Soft | %Total | New | %Total | Old | %Total | Very Old | %Total |
| **1997** | | | | | | | | | |
| Males | 175,986 | 114 | 0.06 | 172,261 | 97.88 | 3,385 | 1.92 | 226 | 0.13 |
| Females | 126,718 | 112 | 0.09 | 122,637 | 96.78 | 3,937 | 3.11 | 32 | 0.03 |

Table 24. Summary of the reproductive status of female brown king crab observed in bycatch samples during the 1996/1997 Aleutian Islands brown king crab fishery.

| Year | Eyed Eggs | Percent Total | Uneyed Eggs | Percent Total | Barren, Mated | Percent Total | Barren, Non-mated | Percent Total |
|---|---|---|---|---|---|---|---|---|
| 1997 | 28,235 | 22.32 | 30,526 | 24.13 | 25,300 | 20.00 | 42,463 | 33.56 |

Table 25. Mean carapace length and shell age statistics derived from retained biological measurements of Korean hair crab during the 1997 Bering Sea Korean hair crab fishery.

| Sample Type | Sample Size | Mean Length | Shell Age (%) | | | |
|---|---|---|---|---|---|---|
| | | | Soft | New | Old | Very Old |
| Catcher Vessel | 4,259 | 95.0 mm | 0.02 | 92.20 | 7.46 | 0.30 |

Table 26. Carapace length frequencies derived from retained biological measurements of Korean hair crabs during Bering Sea Korean hair crab fisheries, 1994 - 1997.

| | 1994 | | 1995 | | 1996 | | 1997 | |
|---|---|---|---|---|---|---|---|---|
| Length (mm) | Num. Crab | Percent | Num. Crab | Percent | Num. Crab | Percent | Num. Crab | Percent |
| 61-65 | 0 | 0.00 | 1 | 0.01 | 0 | 0.00 | 0 | 0.00 |
| 66-70 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| 71-75 | 19 | 0.30 | 40 | 0.53 | 17 | 0.30 | 9 | 0.20 |
| 76-80 | 321 | 5.00 | 450 | 6.02 | 185 | 3.29 | 87 | 2.03 |
| 81-85 | 945 | 14.72 | 968 | 12.95 | 570 | 10.17 | 303 | 7.11 |
| 86-90 | 1,603 | 24.98 | 1,721 | 23.02 | 1,132 | 20.20 | 672 | 15.77 |
| 91-95 | 1,913 | 29.81 | 2,166 | 28.97 | 1,629 | 29.06 | 1,065 | 25.01 |
| 96-100 | 1,191 | 18.56 | 1,515 | 20.26 | 1,412 | 25.20 | 1,217 | 28.56 |
| 101-105 | 392 | 6.11 | 530 | 7.09 | 567 | 10.11 | 698 | 16.38 |
| 106-110 | 31 | 0.47 | 86 | 1.15 | 85 | 1.51 | 190 | 4.46 |
| Totals | 6,415 | 99.95 | 7,477 | 99.99 | 5,597 | 99.84 | 4,241 | 99.52 |
| | Mean Length = | 91.0 mm | Mean Length = | 91.3 mm | Mean Length = | 92.9 mm | Mean Length = | 95.0 mm |

Table 27. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on catcher-processors during the 1997 Bering Sea Korean hair crab fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 5,463 pot lifts sampled from all 16 vessels that participated in the fishery.

| Species / Sex Class | Total Pot Sample Catch | Estimated CPUE For Sampled Fleet | Estimated Total Fishery Catch [a] |
|---|---|---|---|
| Korean hair crab | | | |
| legal males | 12,302 | 2.48 (0.03) [b] | 525,000 [c] |
| sublegal males | 630 | 0.12 [d] | 24,400 |
| females | 538 | 0.10 [d] | 20,900 |
| *opilio* Tanner crab | | | |
| legal males | 20,105 | 4.14 (0.08) | 878,000 |
| sublegal males | 1,671 | 0.31 [d] | 64,800 |
| females | 35 | <0.01 [d] | 1,350 |

[a] Estimated CPUE multiplied by 211,970 total pot lifts (ADF&G, Westward Region staff 1998) during fishery.

[b] Actual CPUE for retained legal crabs for the fishery as reported on confidential interviews forms was 2.1 for observed vessels; actual total fishery CPUE of retained legal crabs was 2 .0 for all vessels (ADF&G, Westward Region staff 1998).

[c] Actual catch of retained legal crabs for the fishery was 420,121 (ADF&G, Westward Region staff 1998).

[d] CPUE computed as total pot sample catch divided by 5,463 pots sampled; standard errors of estimates were not computed.

Table 28. Shell age statistics for Korean hair crab males and females observed in bycatch samples during the Bering Sea Korean hair crab fisheries, 1994 - 1997.

| Fishery Year | Sample Size | Shell Age Classes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Soft | %Total | New | %Total | Old | %Total | Very Old | %Total |
| **1994** | | | | | | | | | |
| Males | 4,088 | 1 | 0.02 | 3,437 | 84.08 | 595 | 14.55 | 55 | 1.35 |
| Females | 91 | 0 | 0.00 | 86 | 94.51 | 5 | 5.49 | 0 | 0.00 |
| **1995** | | | | | | | | | |
| Males | 13,663 | 2 | 0.01 | 11,755 | 86.04 | 1,830 | 13.39 | 76 | 0.56 |
| Females | 708 | 0 | 0.00 | 644 | 90.96 | 62 | 8.76 | 2 | 0.28 |
| **1996** | | | | | | | | | |
| Males | 7,063 | 6 | 0.08 | 4,499 | 63.70 | 2,159 | 30.57 | 399 | 5.65 |
| Females | 573 | 11 | 1.92 | 516 | 90.05 | 41 | 7.16 | 5 | 0.87 |
| **1997** | | | | | | | | | |
| Males | 5,257 | 0 | 0.00 | 4,481 | 85.24 | 711 | 13.52 | 65 | 1.24 |
| Females | 193 | 0 | 0.00 | 178 | 92.23 | 14 | 7.25 | 1 | 0.52 |

Table 29. Summary of the reproductive status of female Korean hair crab observed in bycatch samples during the 1994 - 1997 Bering Sea Korean hair crab fisheries.

| Year | Eyed Eggs | Percent Total | Uneyed Eggs | Percent Total | Barren, Mated | Percent Total | Barren, Non-mated | Percent Total |
|---|---|---|---|---|---|---|---|---|
| 1994 | 2 | 2.33 | 14 | 16.28 | 1 | 1.16 | 69 | 80.23 |
| 1995 | 94 | 13.58 | 18 | 2.60 | 148 | 21.39 | 432 | 62.43 |
| 1996 | 122 | 21.18 | 4 | 0.69 | 138 | 23.96 | 312 | 54.17 |
| 1997 | 7 | 3.59 | 2 | 1.03 | 70 | 35.90 | 116 | 59.49 |
| Totals | 225 | 14.52 | 38 | 2.45 | 357 | 82.41 | 929 | 256.31 |

Table 30. Summary of illegally retained crabs from the legal tally sample during the 1997 Bering Sea Korean hair crab fishery.

| Sample Location | Sample Size | Male | | Female | | Other Crabs | Total Percent Illegal | Number Crabs Harvested[a] | Estimated Number Illegal Crabs | Percent Harvest Sampled |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | | | | | |
| Catcher Vessel | 27,042 | 39 | 0.14 | 16 | 0.06 | 36 | 0.34 | 420,121 | 1,414 | 6.44 |

[a] ADF&G, Westward region staff 1998.

Table 31. Observer coverage, pot sampling effort by observers, and relative difference of observer-based CPUE estimates for retained legal crabs from the Actual Observed Fleet CPUE and from the Actual Total Fishery CPUE. Data is from crab fisheries with mandatory observers and seasons ending in 1997.

| Fishery (Table in report referenced) | Vessels | | Pot lifts | | Percent difference of observer-based CPUE estimate from: | |
|---|---|---|---|---|---|---|
| | Observed | Total Fishery | Sampled | Total Fishery | Actual Observed Fleet CPUE[a] | Actual Total Fishery CPUE[b] |
| Bering Sea *opilio* Tanner crab (Table 4) | 13 | 226[c] | 1,695 | 753,636 | -13.5% (21.0) [d] | 1.0% (1.3) [d] |
| St. Matthew District blue king crab (Table 9) | 1 | 117[c] | confidential | 81,117 | confidential | -58.7% (6.8) [d] |
| Bristol Bay red king crab (Table 15) | 8 | 256[c] | 102 | 90,510 | -27.9% (3.8) [d] | -32.9% (4.8) [d] |
| Aleutian Islands brown king crab (Table 22) | 18 | 18[c] | 12,022 | 213,800 | -3.5% (0.2) [d] | -[e] |
| Bering Sea Korean hair crab (Table 27) | 16 | 16[c] | 5,463 | 211,970 | 18.1% (0.4) [d] | -[e] |

[a] Actual Observed Fleet (AOF) CPUE is based on confidential interviews with the operators of observed vessels. Percent difference is computed as: {[(Observer-based CPUE)-(AOF CPUE)]/(AOF CPUE)} X 100%.

[b] Actual Total Fishery (ATF) CPUE is based on fish ticket data on all landings in the fishery. Percent difference is computed as: {[(Observer-based CPUE)-(ATF CPUE)]/(ATF CPUE)} X 100%. Computed only for fisheries with partial observer coverage.

[c] ADF&G, Westward Region Staff, 1998.

[d] Absolute difference in CPUE estimates in parentheses.

[e] Fishery with 100% observer coverage. Comparison with observed fleet CPUE provides comparison with total fishery CPUE.

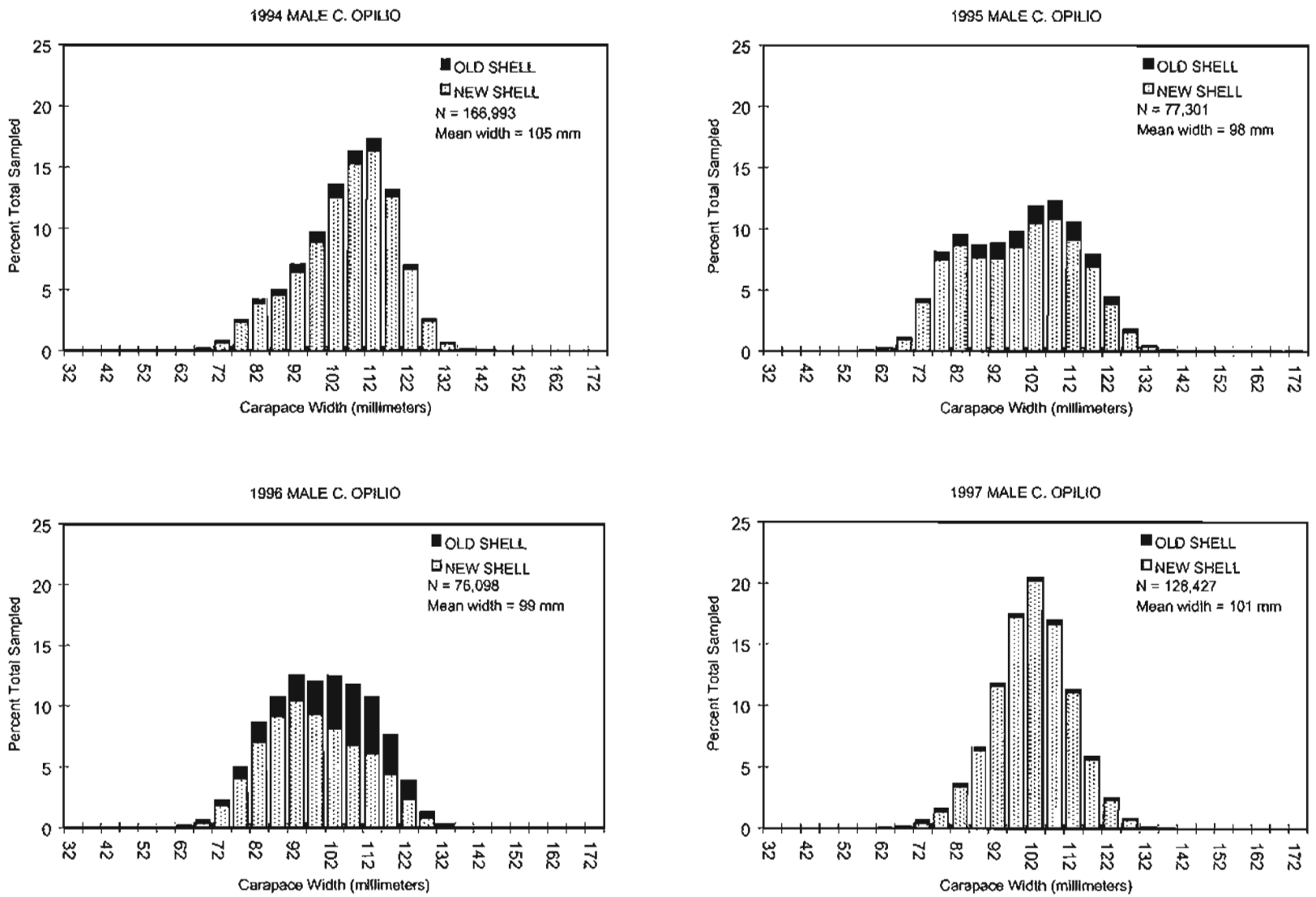


Figure 1. Percent frequency carapace width distribution of all *C. opilio* males sampled from bycatch pots during the Bering Sea *C. opilio* fishery, 1994-1997.

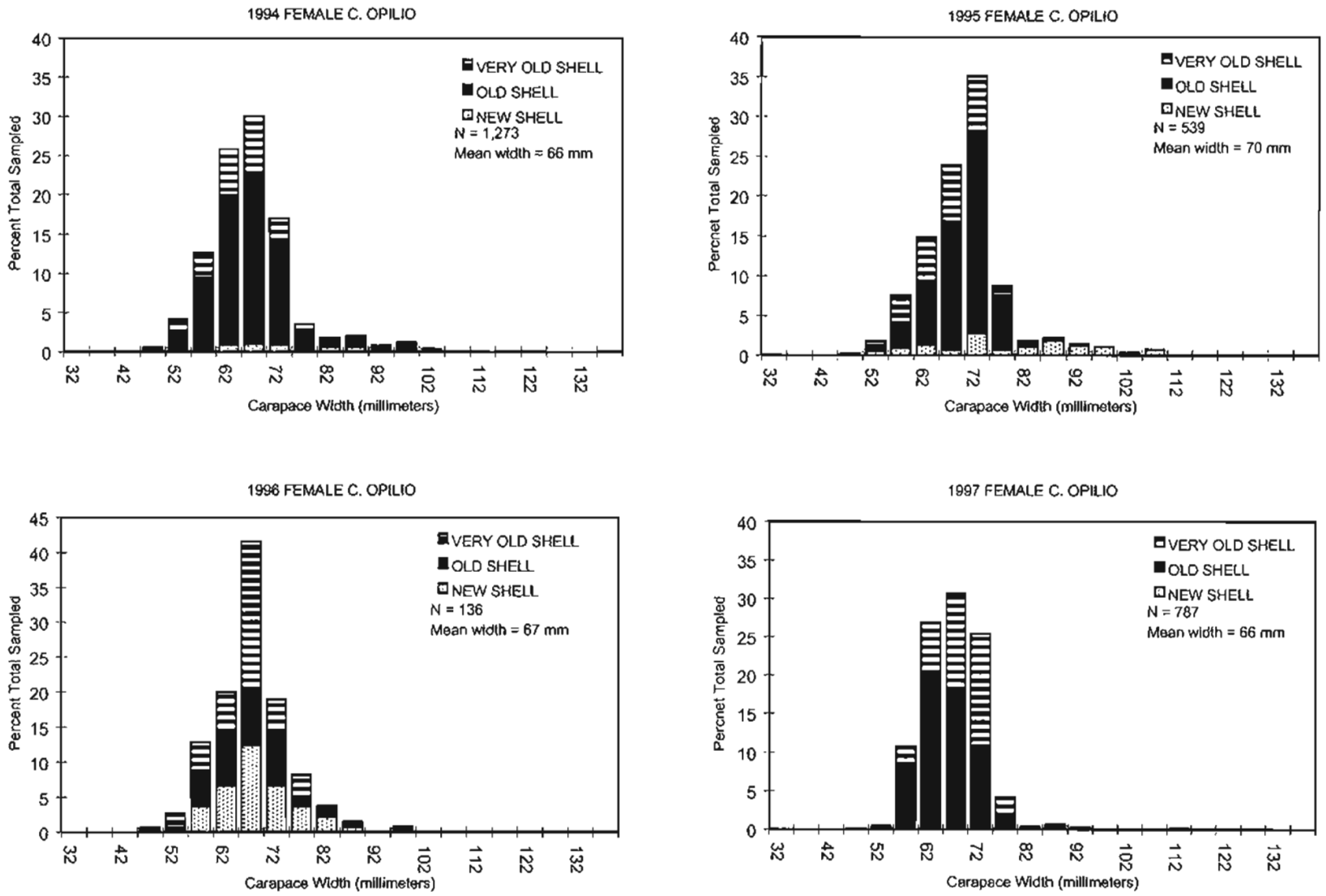


Figure 2. Percent frequency carapace width distribution of all *C. opilio* females sampled from bycatch pots during the Bering Sea *C. opilio* fishery, 1994-1997.

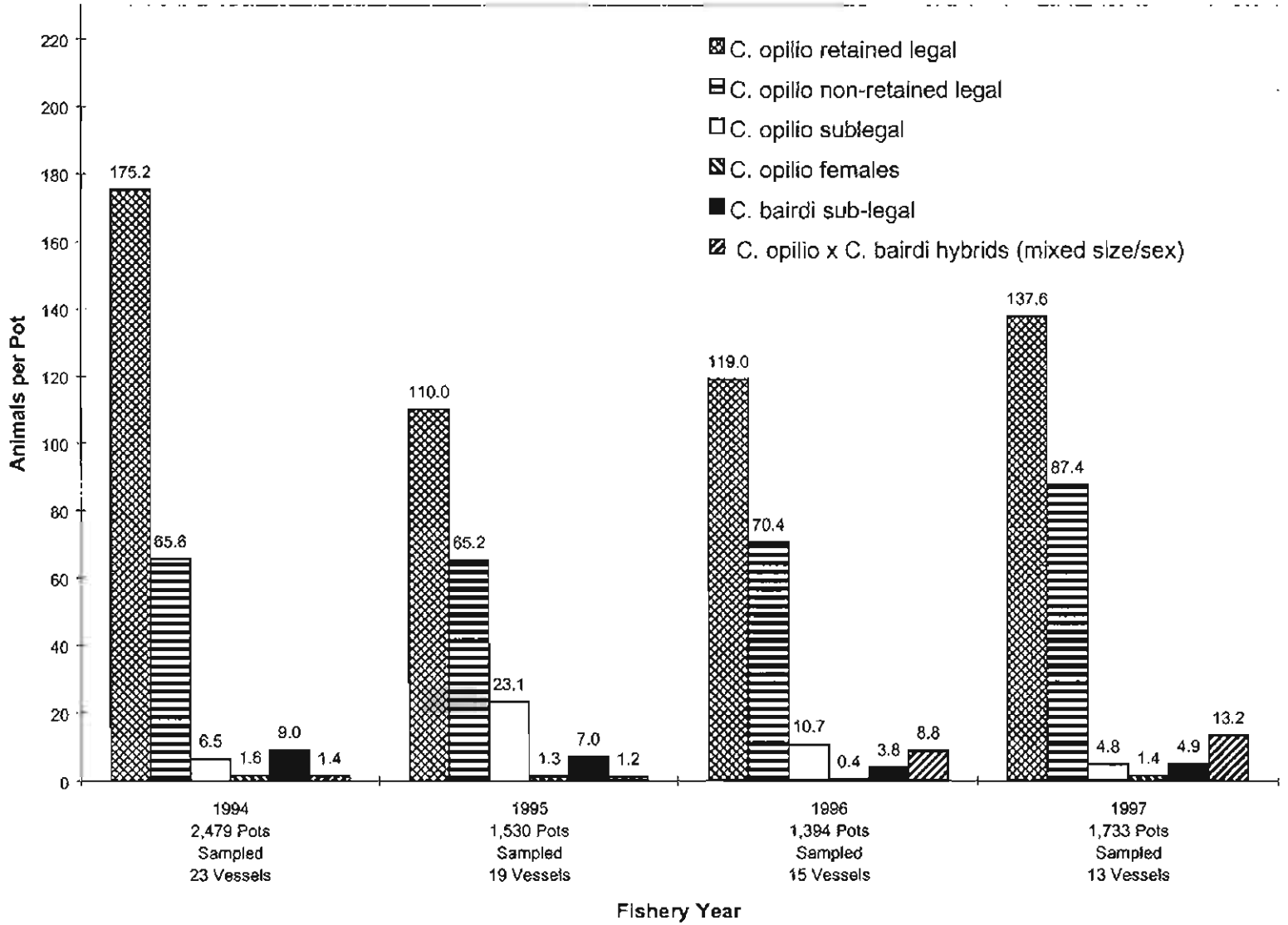


Figure 3. Catch per pot of selected species sampled from bycatch pots during the Bering Sea *C. opilio* fishery, 1994-1997.

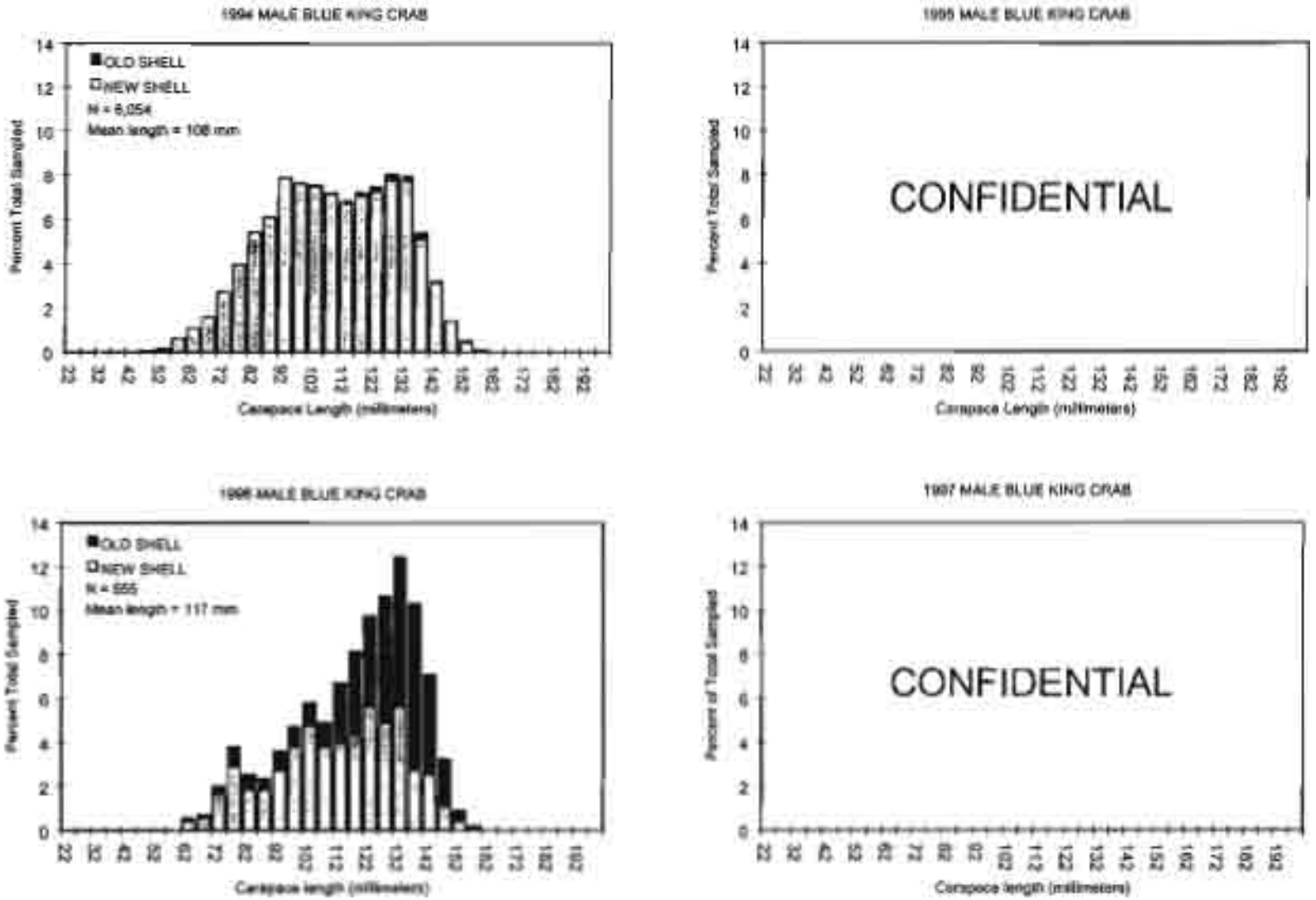


Figure 4. Percent frequency carapace length distribution of all blue king crab males sampled from bycatch pots during the St. Matthew District blue king crab fishery, 1994-1997.

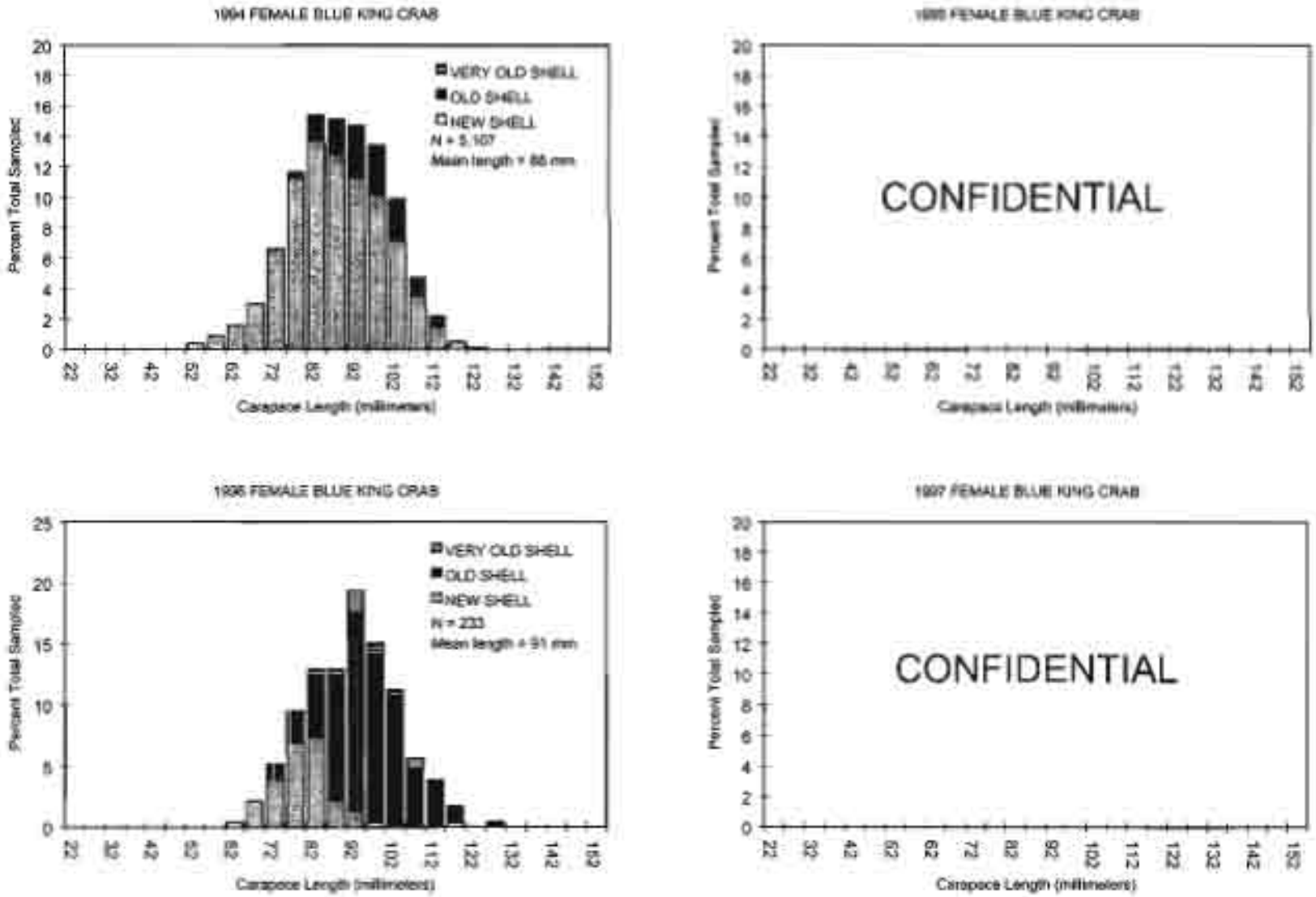


Figure 5. Percent frequency carapace length distribution of all blue king crab females sampled from bycatch pots during the St. Matthew District blue king crab fishery, 1994-1997.

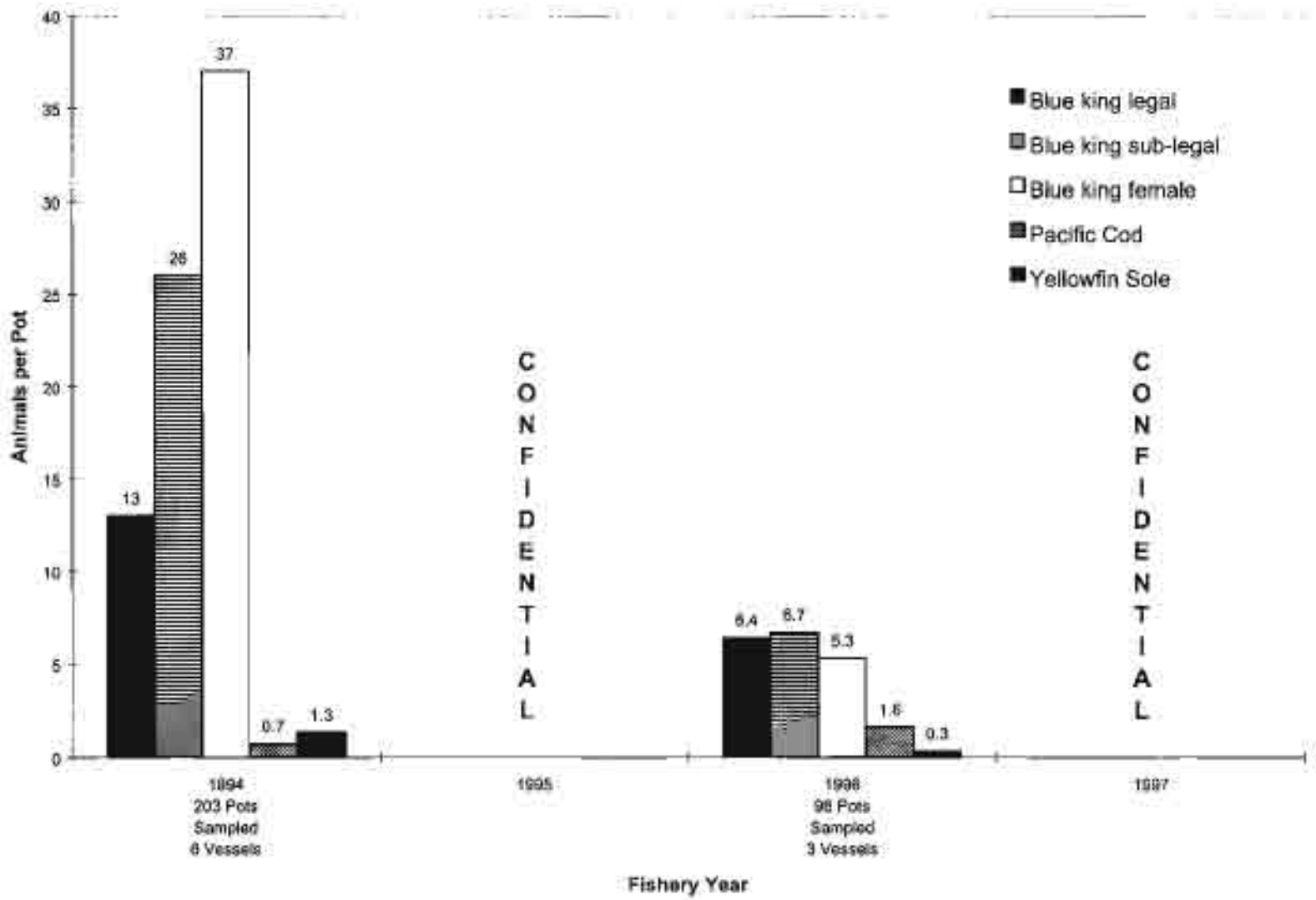


Figure 6. Catch per pot of selected species sampled from bycatch pots during the St. Matthew District blue king crab fishery, 1994-1997.

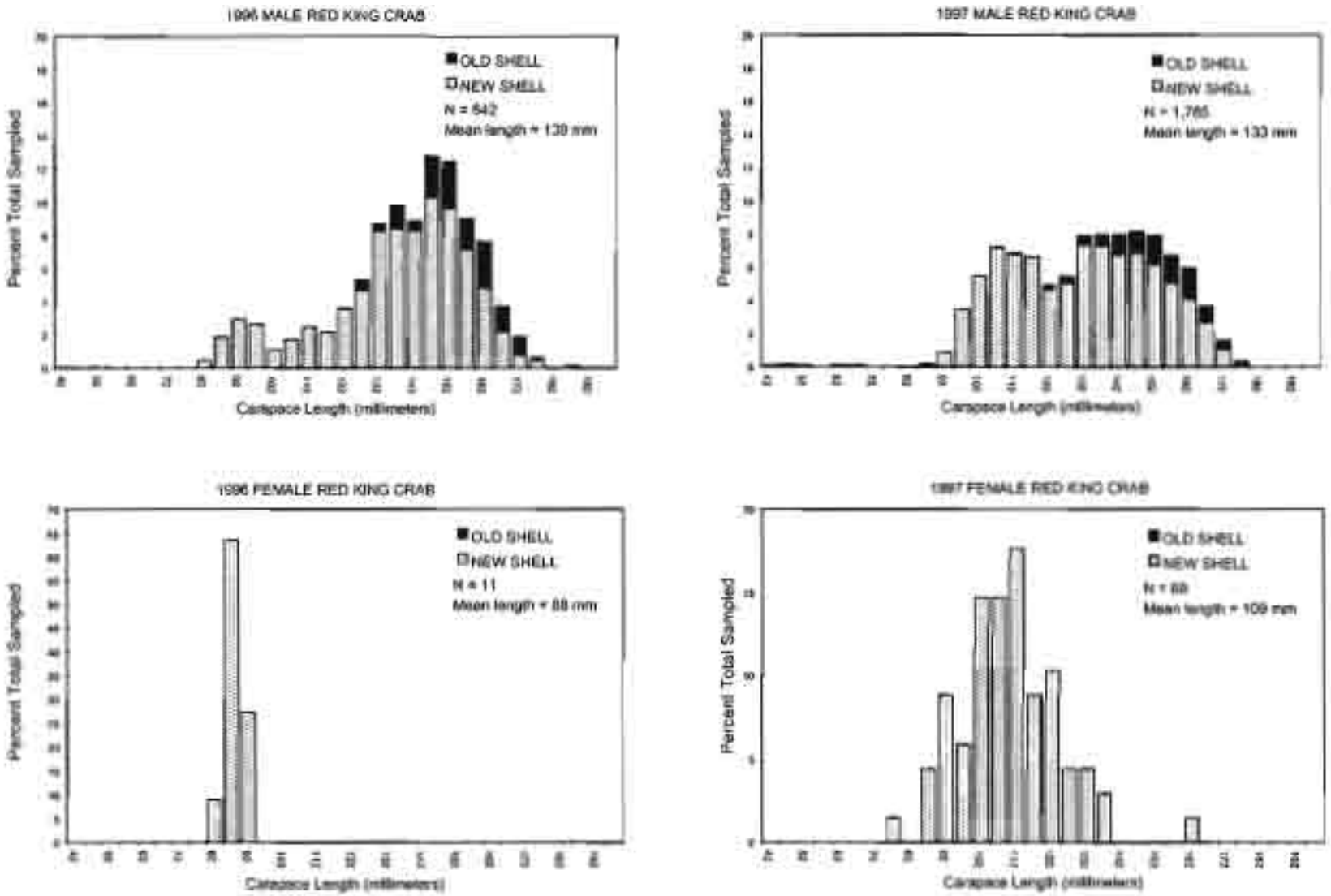


Figure 7. Percent frequency carapace length distribution of all red king crab males and females sampled from bycatch pots during the Bristol Bay area red king crab fishery, 1996-1997.

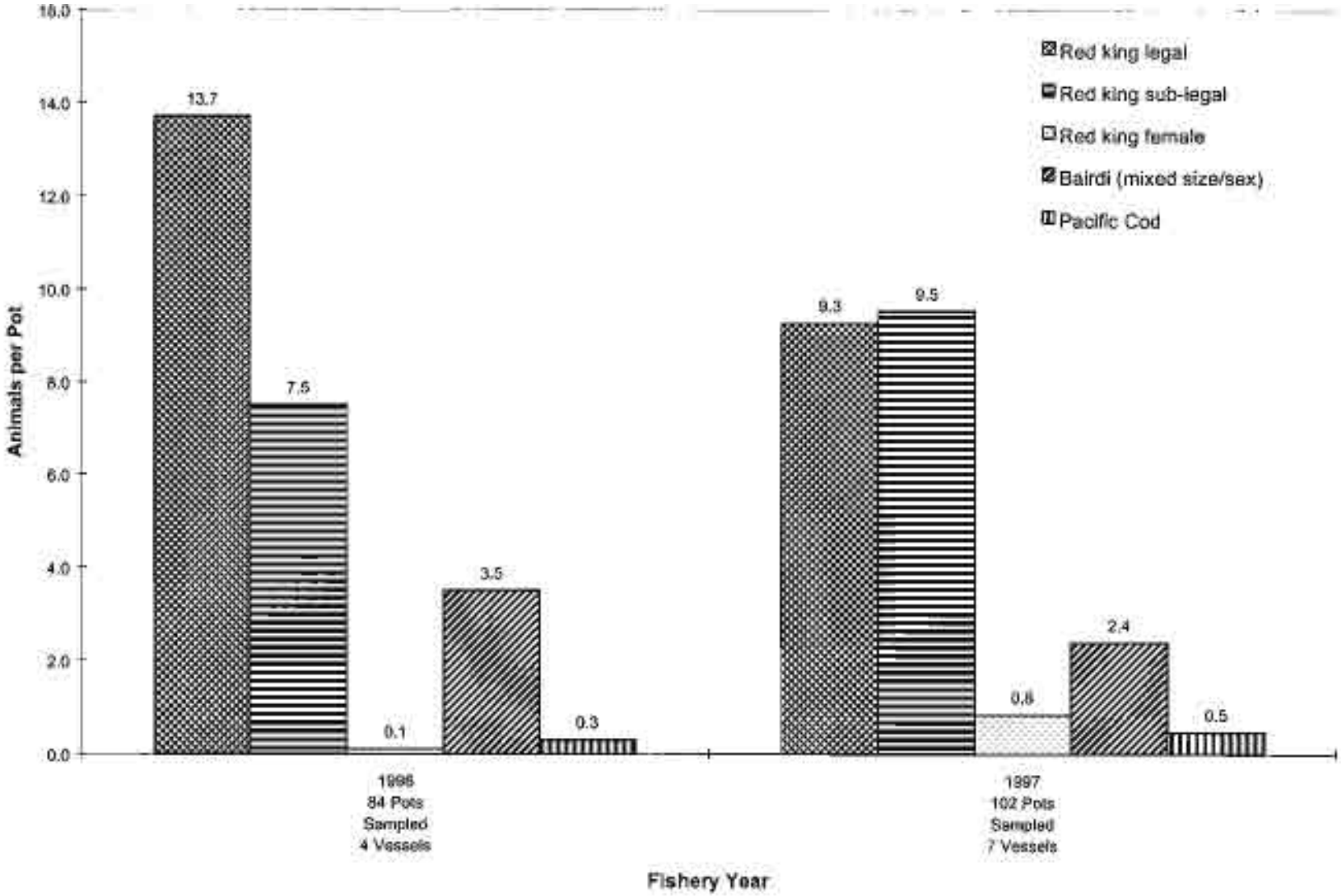


Figure 8. Catch per pot of selected species sampled from bycatch pots during the Bristol Bay area red king crab fishery, 1996-1997.

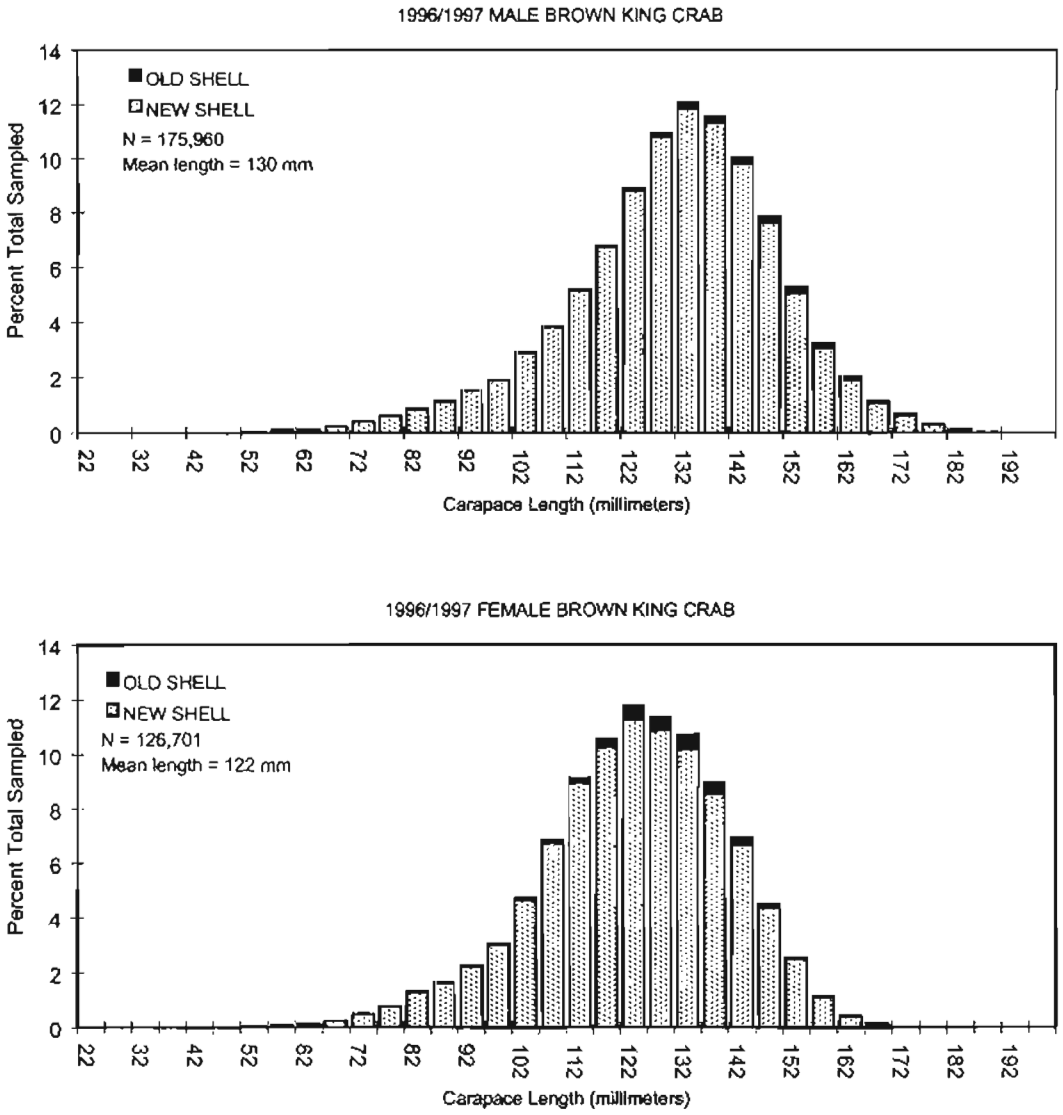


Figure 9. Percent frequency carapace length distribution of all brown king crab males and females sampled from bycatch pots during the Aleutian Islands area brown king crab fishery, 1996/1997.

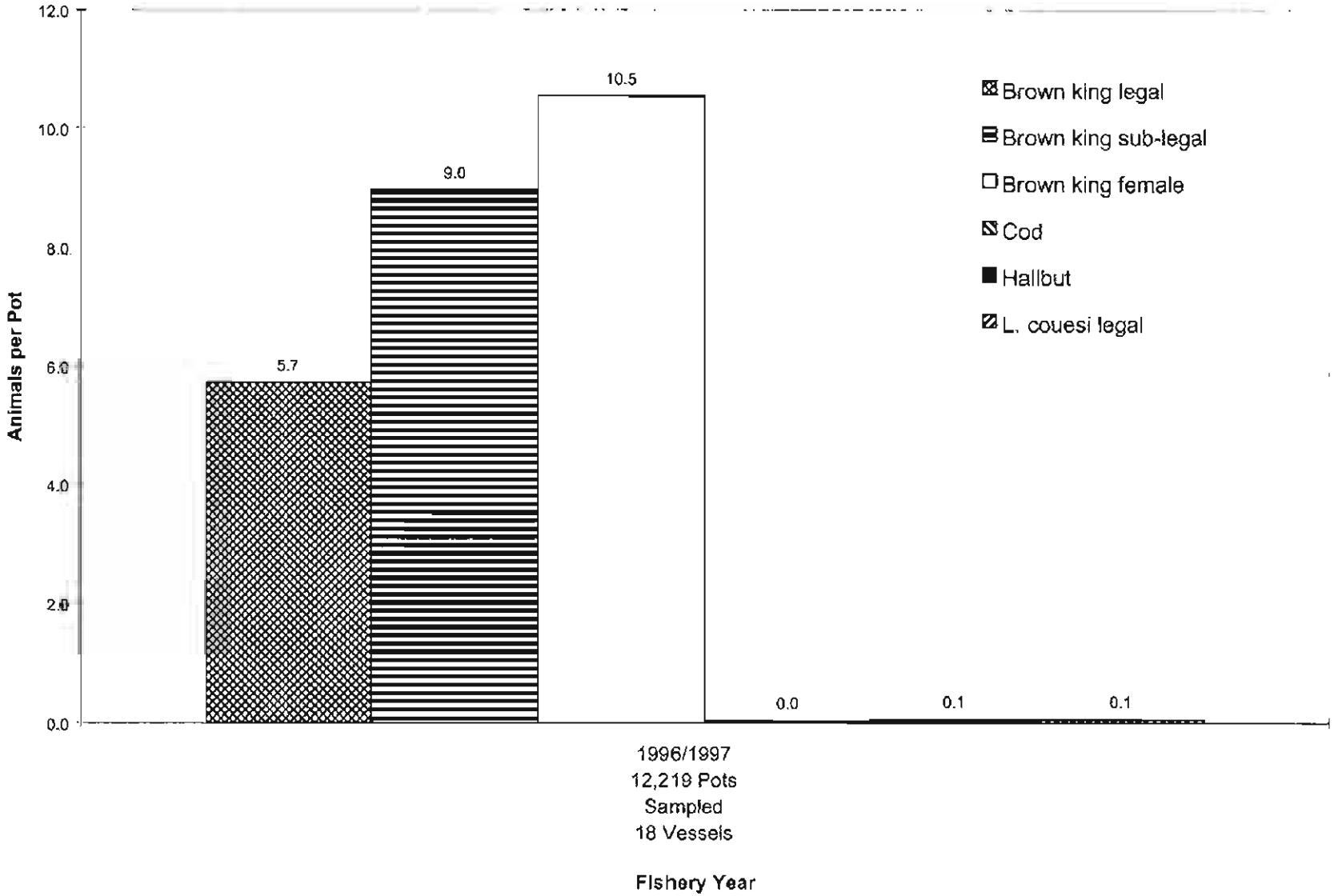


Figure 10. Catch per pot of selected species sampled from bycatch pots during the Aleutian Islands brown king crab fishery, 1997.

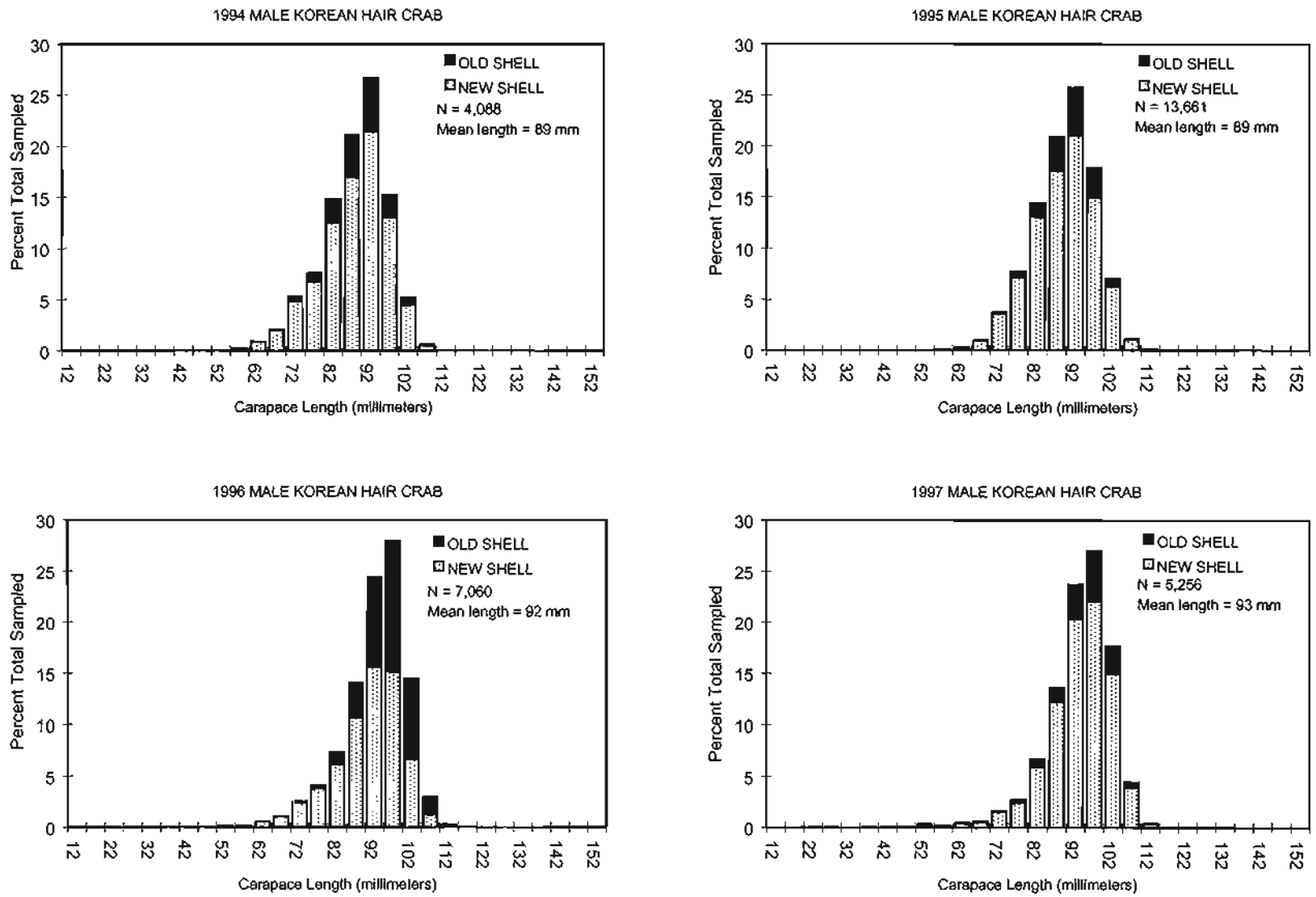


Figure 11. Percent Frequency Carapace length distribution of all Korean hair crab males sampled from bycatch pots during the Bering Sea Korean hair crab fishery, 1994-1997.

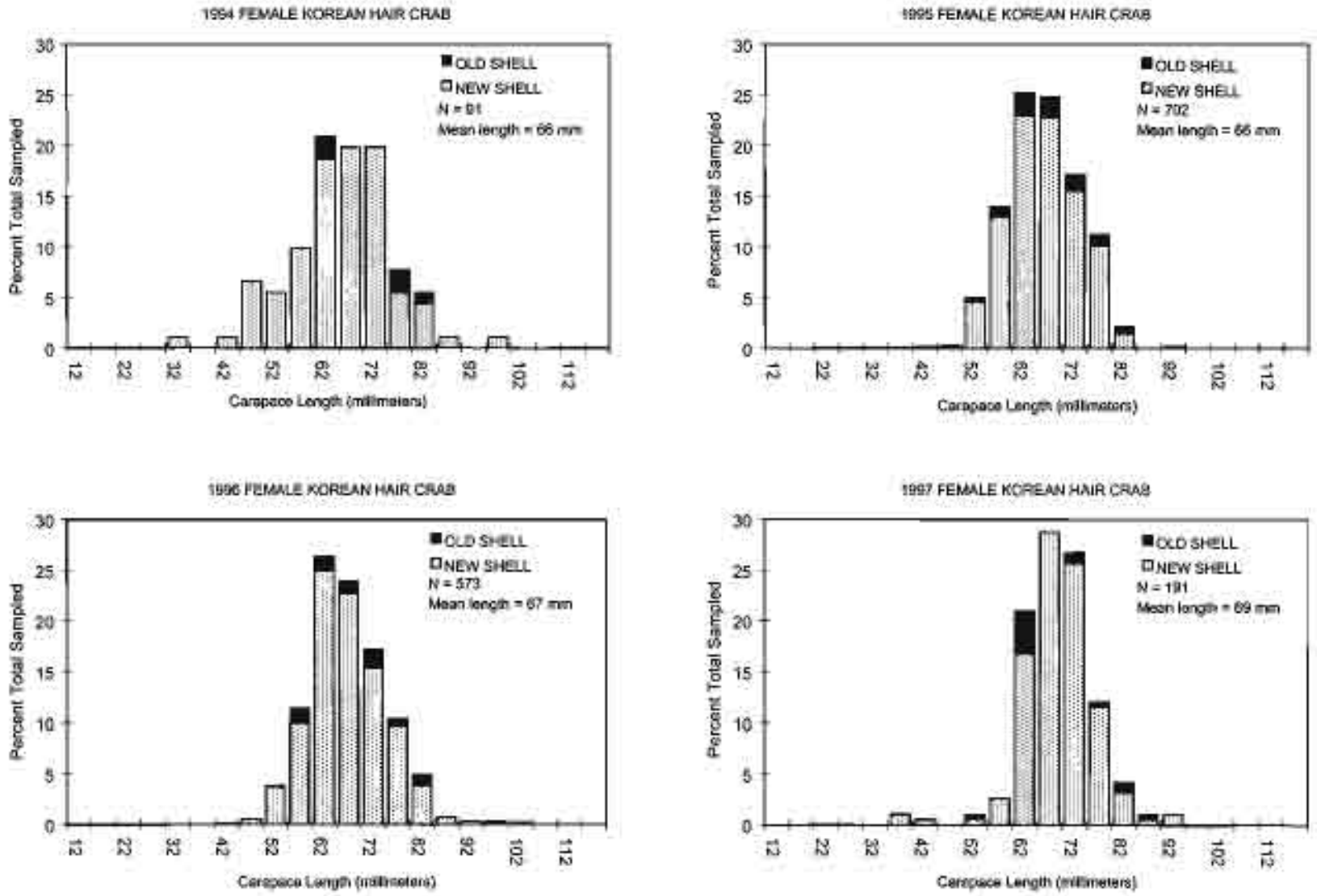


Figure 12. Percent frequency carapace length distribution of all Korean hair crab females sampled in bycatch pots during the Bering Sea Korean hair crab fishery, 1994-1997.

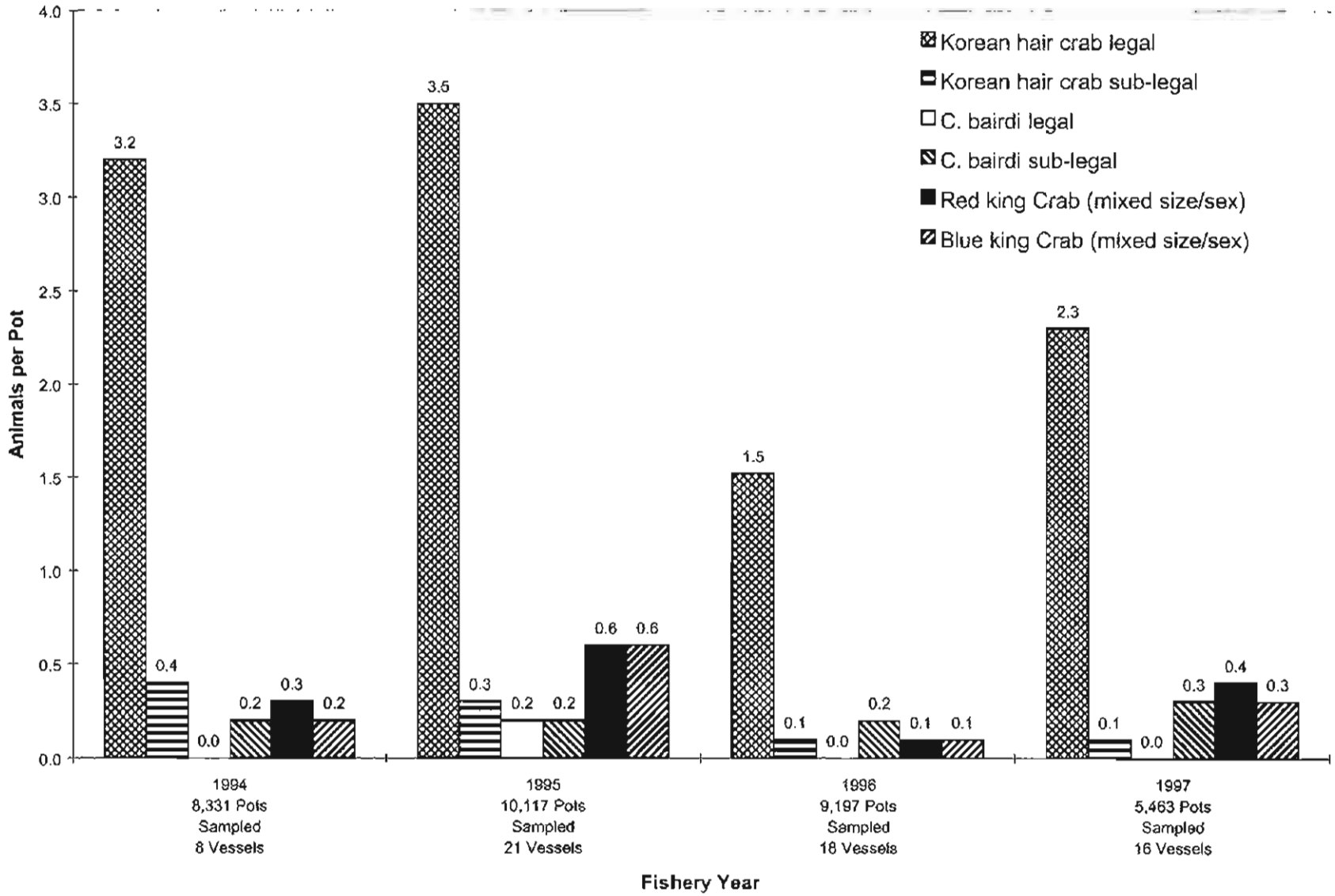


Figure 13. Catch per pot of selected species sampled from bycatch pots during the Bering Sea Korean hair crab fishery, 1994-1997.

# APPENDIX

Appendix A-1. Formulas used to calculate weighted mean and variance estimates for CPUE.

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For a given fishery, observers are instructed to randomly sample $n$ potlifts per day. In practice this number will vary by day, vessel and observer. Observers actually sample $n_{ij}$ pots per day from a total of $N_{ij}$ pots pulled by vessel $i$ on day $j$. Formulas follow Conover (1977).

The mean cpue for vessel $i$ on day $j$ is

$$\bar{x}_{ij\cdot} = 1/ n_{ij} \Sigma_k x_{ijk}$$

and the variance for this estimator is

$$\hat{\text{var}}\ (\bar{x}_{ij\cdot}) = (\Sigma_k (x_{ijk} - \bar{x}_{ij\cdot})^2 / (n_{ij} - 1)) / n_{ij}$$

where x = number of crab in pot sample
$i$ = vessel
$j$ = day
$k$ = pot sampled
$n$ = number of pots sampled.

It follows that

$(\bar{x}_{ij\cdot})\ (N_{ij})$ = estimated total catch by vessel $i$ on day $j$

$\Sigma_j\ (\bar{x}_{ij\cdot}\ N_{ij})$ = estimated total catch by vessel $i$ over the fishery

$(1/N_{i\cdot})\ \Sigma_j\ (\bar{x}_{ij\cdot}\ N_{ij})$ = estimated weighted mean catch per pot lift by vessel $i$ over the fishery

$= \Sigma_j\ (\bar{x}_{ij\cdot})\ (w_{ij})$

$= (\bar{x}_{i\cdot\cdot})$

and

$$\hat{\text{var}}\ (\bar{x}_{i\cdot\cdot}) = \Sigma_j\ \hat{\text{var}}\ (\bar{x}_{ij\cdot})\ w_{ij}^2$$

where $w_{ij} = N_{ij} / N_{i\cdot}$. The weights reflect the importance of a day's sampling based on the number of pots lifted on day $j$ by vessel $i$ relative to the total number of pots lifted by vessel $i$ over the course of the fishery.

---

-Continued-

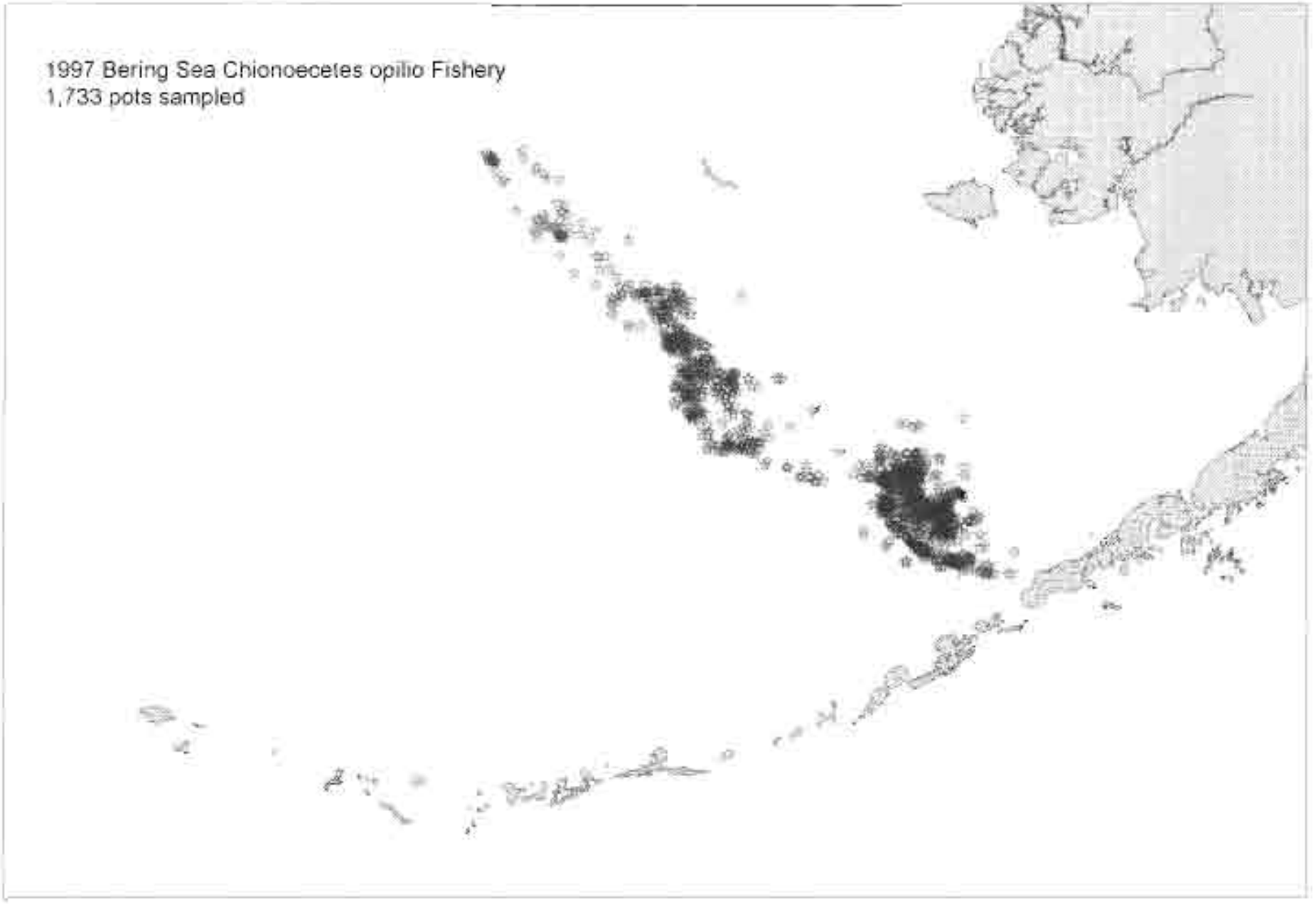
The estimated mean catch per pot lift for all vessels over the fishery is

$$\begin{aligned}\bar{x}\ldots &= (1/N..)\,\Sigma_i\,(\bar{x}_{i\cdot\cdot})\,N_{i\cdot} \\ &= \Sigma_i\,(\bar{x}_{i\cdot\cdot})\,w_i \\ &= (1/N..)\,\Sigma_i\,\Sigma_j\,(\bar{x}_{ij\cdot}\,N_{ij})\end{aligned}$$

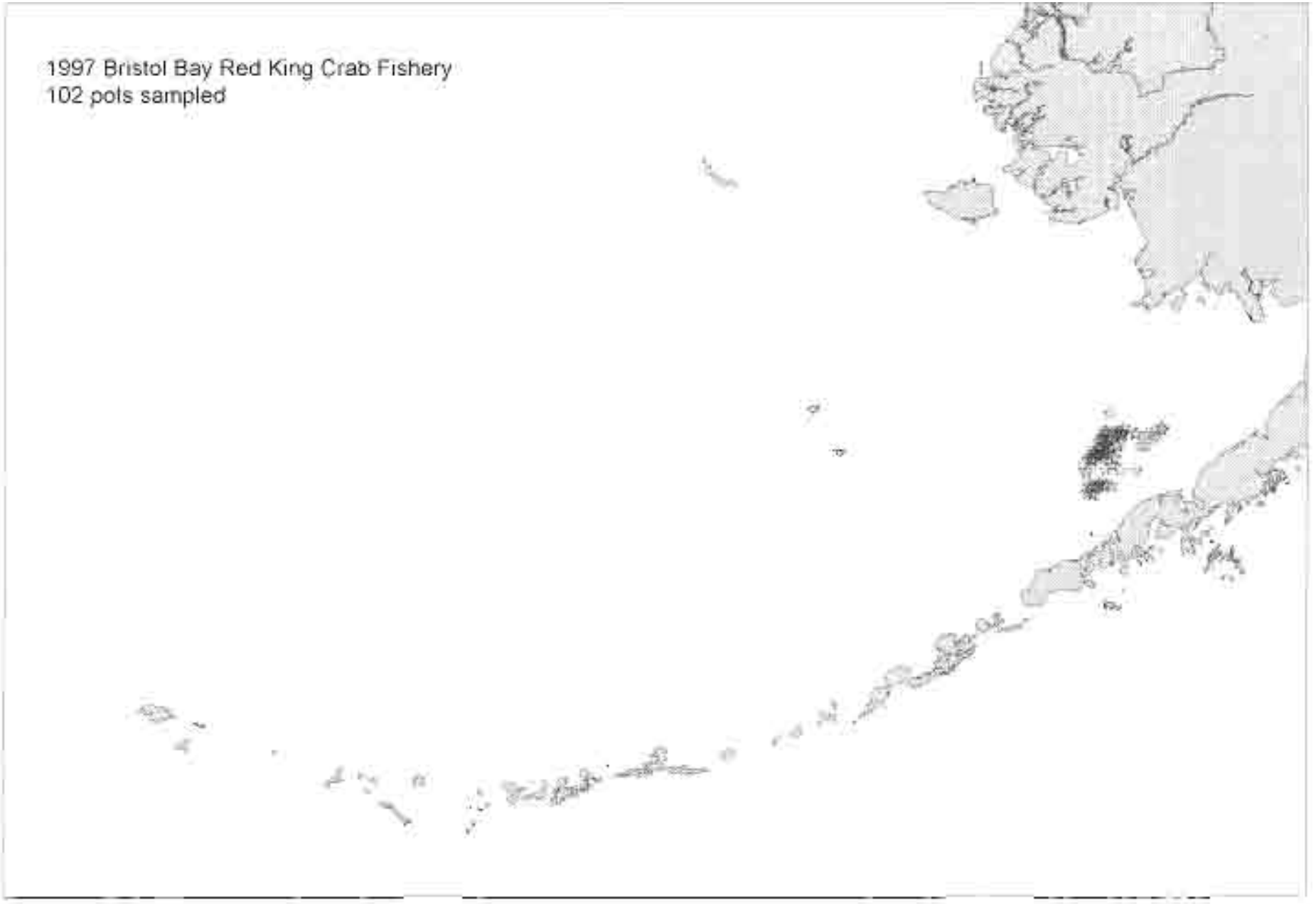
and the variance of this estimator is

$$\begin{aligned}\hat{\mathrm{var}}\,(\bar{x}\ldots) &= \Sigma_i\,\hat{\mathrm{var}}\,(\bar{x}_{i\cdot\cdot})\,w_{i\cdot}^2 \\ &= \Sigma_i\,\Sigma_j\,\hat{\mathrm{var}}\,(\bar{x}_{ij\cdot})(\,w_{ij}^2\,w_{i\cdot}^{-2}\,) \\ &= \Sigma_i\,\Sigma_j\,\hat{\mathrm{var}}\,(\bar{x}_{ij\cdot})(\,N_{ij}/N_{i\cdot})(N_i/N_{\cdot\cdot}) \\ &= \Sigma_i\,\Sigma_j\,\hat{\mathrm{var}}\,(\bar{x}_{ij\cdot})(N_{ij}/N..)^2 \\ &= (1/N..)^2\,\Sigma_i\,\Sigma_j\,\hat{\mathrm{var}}\,(\bar{x}_{ij\cdot})(N_{ij}^2)\end{aligned}$$

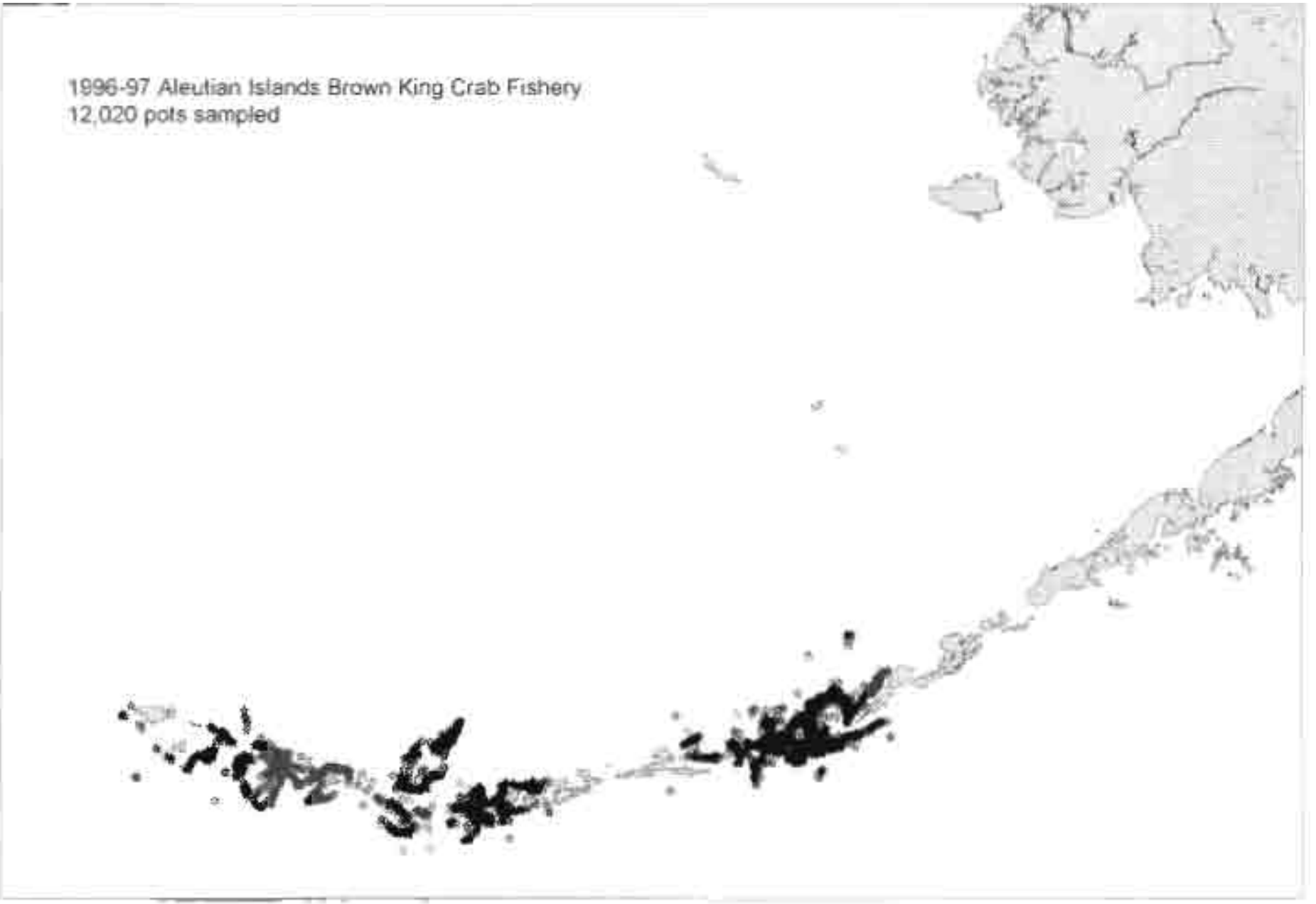
where $w_{i\cdot} = N_{i\cdot} / N..$



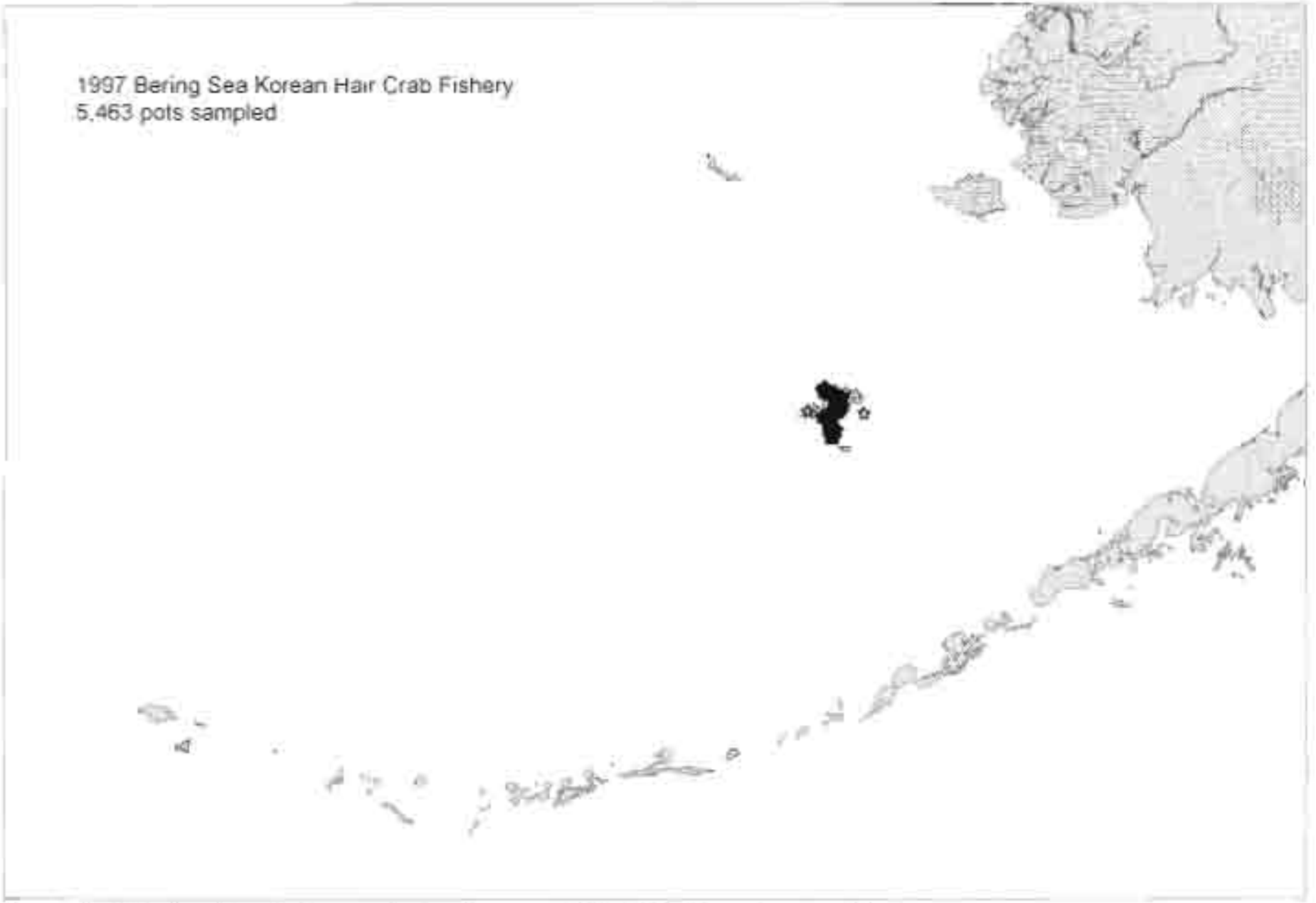

Appendix B-1. Location of pots sampled by observers in the 1997 C. opilio fishery.




Appendix B-3. Location of pots sampled by observers in the 1997Bristol Bay Red King Crab fishery.




Appendix B-4. Location of pots sampled by observers in the 1996-97 Aleutian Islands brown king crab fishery.




Appendix B-5. Location of pots sampled by observers in the 1997 Korean hair crab fishery.

Appendix C-1. Total pot contents from 1,733 randomly sampled pots during the Bering Sea *C. opilio* crab fishery, 1997.

| Species | | Total number observed |
|---|---|---|
| Hermit crab unident. | | 44 |
| Starfish unident. | | 25 |
| Tanner crab, hybrid | Legal Male | 20,878 |
| | Sublegal | 1,726 |
| | Female | 236 |
| Skate unident. | | 1 |
| Halibut | | 103 |
| Greenland turbot | | 3 |
| Flathead sole | | 6 |
| Rock sole | | 1 |
| Yellowfin sole | | 4 |
| Arrowtooth flounder | | 68 |
| Walleye pollock | | 12 |
| Pacific cod | | 691 |
| Prowfish | | 1 |
| Sculpin unident. | | 46 |
| Yellow irish lord | | 13 |
| Snailfish unident. | | 2 |
| Basket starfish unident. | | 4 |
| Snail unident. | | 1,657 |
| Lyre crab | | 67 |
| Sea anemonie | | 15 |
| Octopus | | 5 |
| Hairy triton | | 73 |
| Brown King Crab | Legal Male | 1 |
| | Sublegal | 3 |
| | Female | 8 |
| Tanner Crab, *C. bairdi* | Legal Male | 553 |
| | Sublegal | 8,447 |
| | Female | 1,515 |
| Tanner Crab, *C. opilio* | Legal Male | 390,028 |
| | Sublegal | 8,387 |
| | Female | 2,408 |
| Korean Hair Crab | Legal Male | 0 |
| | Sublegal | 0 |
| | Female | 1 |

Appendix C-3. Total pot contents from 102 randomly sampled pots during the Bristol Bay red king crab fishery, 1997.

| Species | | Total number observed |
|---|---|---|
| Hermit crab unident. | | 1 |
| Starfish unident. | | 183 |
| Tanner crab, hybrid | Legal Male | 1 |
| | Sublegal | 0 |
| | Female | 0 |
| Yellowfin sole | | 38 |
| Pacific cod | | 48 |
| Rockfish unident. | | 2 |
| Sculpin unident. | | 8 |
| Bigmouth sculpin | | 2 |
| Yellow irish lord | | 5 |
| Mussel unident. | | 1 |
| Snail unident. | | 7 |
| Lyre crab | | 1 |
| Jellyfish unident. | | 1 |
| Tunicate unident. | | 1 |
| Sponge unident. | | 1 |
| Red King Crab | Legal Male | 945 |
| | Sublegal | 971 |
| | Female | 85 |
| Tanner Crab, *C. bairdi* | Legal Male | 160 |
| | Sublegal | 73 |
| | Female | 10 |
| Tanner Crab, *C. opilio* | Legal Male | 13 |
| | Sublegal | 10 |
| | Female | 1 |
| Korean Hair Crab | Legal Male | 2 |
| | Sublegal | 0 |
| | Female | 0 |

Appendix C-4. Total pot contents from 12,022 randomly sampled pots during the Aleutian Island area brown king crab fishery, 1996/1997.

| Species | | Total number observed |
|---|---|---|
| *Placetron wosnessenskii* | | 8 |
| Hermit crab unident. | | 3 |
| *Lithodes couesi* | Legal Male | 680 |
| | Sublegal | 107 |
| | Female | 154 |
| *Paralomis multispina* | Legal Male | 0 |
| | Sublegal | 0 |
| | Female | 1 |
| *Chionoecetes tanneri* | Legal Male | 22 |
| | Sublegal | 12 |
| | Female | 11 |
| *Chionoecetes angulatus* | Legal Male | 2 |
| | Sublegal | 2 |
| | Female | 2 |
| Starfish unident. | | 783 |
| Shrimp unident. | | 1 |
| Skate unident. | | 62 |
| Flatfish unident. | | 30 |
| Halibut | | 666 |
| Greenland turbot | | 88 |
| Flathead sole | | 1 |
| Rex sole | | 1 |
| Dover sole | | 1 |
| Butter sole | | 1 |
| Yellowfin sole | | 1 |
| Arrowtooth flounder | | 105 |
| Starry flounder | | 1 |
| Turbot unident. | | 1 |
| Walleye pollock | | 3 |
| Pacific cod | | 360 |
| Sablefish | | 42 |
| Atka mackerel | | 7 |
| Prowfish | | 4 |
| Grenadiers; rattails | | 9 |
| Rockfish unident. | | 32 |
| Pacific ocean perch. | | 18 |
| Bocaccio | | 2 |
| Northern rockfish | | 2 |

-Continued-

Appendix C-4. (page 2 of 2)

| Species | | Total number observed |
|---|---|---|
| Rougheye rockfish | | 43 |
| Yelloweye rockfish | | 14 |
| Shortspine thornyhead | | 16 |
| Sculpin unident. | | 117 |
| Spinyhead sculpin | | 2 |
| Bigmouth sculpin | | 6 |
| Great sculpin | | 3 |
| Yellow irish lord | | 90 |
| Snailfish unident. | | 9 |
| Ling cod | | 1 |
| Basket starfish unident. | | 398 |
| Brittle star | | 144 |
| Mussel unident. | | 1 |
| Weathervane scallop | | 1 |
| Snail unident. | | 610 |
| Lyre crab | | 74 |
| Jellyfish unident. | | 1 |
| Sea urchin unident. | | 390 |
| Sea cucumber unident. | | 5 |
| Tunicate unident. | | 3 |
| Barnacle unident. | | 1 |
| Sea anemone | | 11 |
| *Neptunea* spp. | | 1 |
| Octopus | | 56 |
| Sponge unident. | | 48 |
| Red King Crab | Legal Male | 29 |
| | Sublegal | 43 |
| | Female | 23 |
| Brown King Crab | Legal Male | 68,798 |
| | Sublegal | 107,685 |
| | Female | 126,786 |
| Tanner Crab, *C. bairdi* | Legal Male | 0 |
| | Sublegal | 3 |
| | Female | 2 |
| Korean Hair Crab | Legal Male | 7 |
| | Sublegal | 10 |
| | Female | 1 |

Appendix C-5. Total pot contents from 5,463 randomly sampled pots during the Bering Sea hair crab fishery, 1997.

| Species | | Total number observed |
|---|---|---|
| *Placetron wosnessenskii* | | 1 |
| *Paralomus verilli* | | 3 |
| Hermit crab unident. | | 912 |
| Starfish unident. | | 12,119 |
| Decorator crab | | 4 |
| Tanner crab, hybrid | Legal Male | 49 |
| | Sublegal | 30 |
| | Female | 4 |
| Shrimp unident. | | 1 |
| Halibut | | 1 |
| Rock Sole | | 5 |
| Yellowfin sole | | 15 |
| Pacific cod | | 514 |
| Searcher | | 2 |
| Sculpin unident. | | 754 |
| Yellow irish lord | | 370 |
| Snailfish unident. | | 2 |
| Basket starfish unident. | | 1 |
| Brittle star | | 1 |
| *Chlamys* spp. | | 1 |
| Snail unident. | | 408 |
| Lyre crab | | 462 |
| Sea urchin unident. | | 31 |
| Sea cucumber unident. | | 3 |
| Sea anemonie | | 1 |
| Octopus | | 21 |
| Sponge unident. | | 4 |
| Red King Crab | Legal Male | 15 |
| | Sublegal | 694 |
| | Female | 1,571 |
| Blue King Crab | Legal Male | 42 |
| | Sublegal | 336 |
| | Female | 1,355 |
| Tanner Crab, *C. bairdi* | Legal Male | 71 |
| | Sublegal | 1,784 |
| | Female | 1,648 |
| Tanner Crab, *C. opilio* | Legal Male | 20,105 |
| | Sublegal | 1,671 |
| | Female | 35 |
| Korean Hair Crab | Legal Male | 12,302 |
| | Sublegal | 630 |
| | Female | 541 |

Appendix C-6. Total pot contents from 3,372 randomly sampled pots during the Bering Sea snail fishery, 1997.

| Species | | Total number observed |
|---|---|---|
| Hermit crab unident. | | 6,572 |
| Starfish unident. | | 43 |
| Tanner crab, hybrid | Legal Male | 0 |
| | Sublegal | 3 |
| | Female | 0 |
| Yellowfin sole | | 5 |
| Pacific cod | | 70 |
| Sculpin unident. | | 6 |
| Snailfish unident. | | 1 |
| Snail unident. | | 6,896 |
| Lyre crab | | 1,109 |
| Sea urchin unident. | | 1 |
| *Neptunea* spp. | | 12,301 |
| *Buccinum* spp. | | 35,032 |
| Hairy triton | | 216 |
| *Neptunea lyrata* | | 381 |
| *Neptunea pribliloffensis* | | 49,998 |
| *Neptunea heros* | | 29 |
| *Plicifusus kroeyeri* | | 403 |
| Tanner Crab, *C. bairdi* | Legal Male | 0 |
| | Sublegal | 37 |
| | Female | 304 |
| Tanner Crab, *C. opilio* | Legal Male | 257 |
| | Sublegal | 1,029 |
| | Female | 15 |